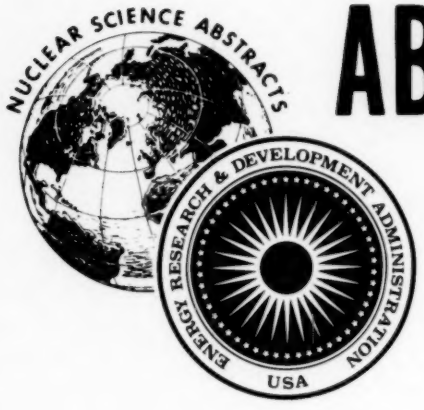
NUCLEAR SCIENCE ABSTRACTS



Volume 33 Number 11

Abstracts 25338-28271

June 15, 1976

FINAL VOLUME
See Notice Inside

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of ERDA and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, ERDA's Technical Progress Reviews, ERDA-sponsored translations, conference proceedings published by ERDA, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of ERDA reports in countries other than the United States are listed on the inside back cover.

ALABAMA
Auburn, Auburn University
Tuskegee Institute, Tuskegee Institute

ARIZONA
Tucson, University of Arizona

CALIFORNIA
Davis, University of California
Los Angeles, University of California
Santa Barbara, University of California

COLORADO
Boulder, University of Colorado

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

IDAHO
Pocatello, Idaho State University

ILLINOIS
Urbana, University of Illinois

INDIANA
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Massachusetts Institute of Technology
Worcester, Worcester Polytechnic Institute

MICHIGAN
Ann Arbor, University of Michigan

MISSISSIPPI
State College, Mississippi State University

MISSOURI
Columbia, University of Missouri
Kansas City, Linda Hall Library

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Albany, New York State Library
Albany, State University at Albany
Ithaca, Cornell University
New York, Columbia University
Rochester, University of Rochester
Syracuse, Syracuse University

NORTH CAROLINA
Raleigh, North Carolina State University

OHIO
Cincinnati, University of Cincinnati
Cleveland, Cleveland Public Library
Toledo, University of Toledo

OKLAHOMA
Norman, University of Oklahoma

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
San Juan, University of Puerto Rico

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee

TEXAS
Austin, University of Texas
College Station, Texas A & M University
Houston, Rice University

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin

ERDA reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

Volume 33, Number 11, June 15, 1976

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

- Atomic Energy of Canada Limited
- Australian Atomic Energy Commission
- Danish Atomic Energy Commission
- Finnish Atomic Energy Commission
- French Atomic Energy Commission
- Japan Atomic Energy Bureau–Atomic Energy Research Institute
- Commissie Nucleaire Informatieverzorging (Netherlands)
- Institutt for Atomenergi (Norway)
- Aktiebolaget Atomenergi (Sweden)
- United Kingdom Atomic Energy Authority
- Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

NOTICE

The publication of *Nuclear Science Abstracts* is planned to be discontinued after Vol. 33, No. 12, dated June 30, 1976. *Atomindex*, published by the International Atomic Energy Agency and a product of the International Nuclear Information System (INIS), will provide essentially identical literature coverage, subject scope, abstracting and indexing with that of *NSA*. For all practical purposes the two journals are identical. The Energy Research and Development Administration, formerly the Atomic Energy Commission, has supported the concept and development of INIS for several years. At this time, it is quite apparent that the decentralized scanning, abstracting and indexing on a country-by-country basis is reliable and successful. Consequently, it is no longer necessary for the United States to bear the entire burden of publishing an abstract journal covering the world's nuclear literature. ERDA will continue to provide coverage of U. S. nuclear literature to INIS.

Atomindex is available on a subscription basis in the United States from UNIPUB, P. O. Box 433, Murray Hill Station, New York, New York 10016, for $150 per year including cumulative indexes. ($110 per year without cumulative indexes.) For others, *Atomindex* is available from the International Atomic Energy Agency, Publications Section, P. O. Box 590, A-1011, Vienna, Austria, at the same price.

ERDA's new journal, *ERDA Energy Research Abstracts (ERA)*, will contain abstracts and indexes to all literature of ERDA origin as well as nonnuclear energy information generated by foreign countries with which ERDA has agreements for cooperation. *ERA* is available to government agencies on the same basis as *NSA* and on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information.

The public may obtain *ERA* from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The annual subscription rate for the 12 regular issues including an annual cumulative index is $119 for domestic subscribers, and $148.75 for foreign subscribers. Individual issues will be priced at $7.40 domestic, and $9.25 foreign. Separate annual index cumulations will cost $30.50 domestic, and $38.15 foreign.

INDEXES TO *NSA*

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SOLDAN, D.W., Shipping container for a bottle of radioactive material, 32:20442

SOLDAT, J.K., Dosimetry of the radioactive noble gases, 32:19918 (BNWL-SA-4813)

SOLOMAKHA, D.A., Measurement of the 1.15-μm wavelength of a helium--neon laser, 32:19555

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

URANIUM ORES/GEOCHEMISTRY
  Change of uranium concentration in plagioclase of various zones of microcline--albite--oligoclase pegmatites of Karelia, 32:19704
URANIUM ORES/LEACHING
  Preparation of uranium compounds (Patent), 32:19329
URANIUM ORES/MINING
  The uranium mining and its importance for the energy supply, 32:19701
URANIUM ORES/ORE PROCESSING
  Supplies for the fuel cycle for Spanish nuclear power plants, 32:19702
URANIUM OXIDES
  See also URANIUM DIOXIDE
  URANIUM OXIDES U3O8

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

20457 (LA-5954) 100-MHz POWER AMPLIFIER DESIGN AND CONTROL FOR A HEAVY-ION ACCELERATOR. Lunsford, J. S.; Shipley, J. P.; Sutton, J. **(Los Alamos Scientific Lab., N. Mex. (USA)).** Jul 1975. 11p. Dep. NTIS $4.00.

is indexed as:

LOS ALAMOS SCIENTIFIC LAB., N.MEX. (USA)
  100-MHz power amplifier design and control for a heavy-ion accelerator, 32:20457 (LA-5954)
  Characterization of transuranic solid wastes from a plutonium processing facility, 32:19398 (LA-5993-MS)
  Electrical breakdown and tracking characteristics of pulsed high voltages in cryogenic helium and nitrogen, 32:19495 (LA-UR-75-1032)
  Engineering concepts for laser-fusion reactor applications, 32:19493 (LA-UR-75-736)
  Evaluation of pre-impregnated resin-glass systems for insulating superconducting magnets, 32:19583 (LA-UR-75-1099)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

L-	(Misc.)	
9389	32:20494	See N-74-35219
LA-		
2429	32:20210	Dep. NTIS, $12.00
5931	32:21563	Dep. NTIS, $5.45
LA-tr-		
75-14	32:21506	Dep. NTIS, $7.75
75-26	32:19253	Dep. NTIS, $4.00
LA-UR-		
75-736	32:19493	Dep. NTIS, $4.00
75-791	32:20772	Dep. NTIS, $4.50
75-1331	32:19238	Dep. NTIS, $4.00
LBL-		
2874	32:19889	Dep. NTIS, $9.25
3633	32:21097	Dep. NTIS, $13.50
LFEN-	(Portugal)	
165-b	32:21507	INIS

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 33, Number 11, June 15, 1976

Category	Page
CHEMISTRY	2517
Analytical and Separations Chemistry	2517
Activation and Nuclear Reaction Procedures	2517
Chemical and Spectral Procedures	2519
Radiometric and Radiochemical Procedures	2521
Separation Procedures	2522
Inorganic, Organic, and Physical Chemistry	2524
Chemical and Physicochemical Properties	2524
Isotope Effects	2525
Isotope Exchange and Isotope Separation	2527
Feed Materials Processing	2528
Radiation Chemistry	2528
Radiochemistry and Nuclear Chemistry	2533
Hot-Atom Chemistry	2533
Properties of Radioactive Materials	2534
Radioactive Waste Treatment	2537
Radioisotope Production	2538
Reactor Fuel Reprocessing	2539
CONTROLLED THERMONUCLEAR RESEARCH	2540
Plasma Confinement and Heating	2540
Plasma Diagnostics	2542
Plasma Kinetics (General)	2543
Plasma Kinetics (Experimental)	2545
Plasma Kinetics (Theoretical)	2546
Plasma Production	2546
Plasma Stability	2547
Thermonuclear Engineering and Equipment	2549
Wave Phenomena	2553
ENGINEERING	2556
Energy Conversion	2556
Facilities and Equipment	2556
Lasers	2556
Cryogenic and Superconducting Equipment and Devices	2563
Heat Transfer and Fluid Flow	2568
Materials Testing	2569
Nuclear Explosions	2571
Protective Structures and Equipment	2574
ENVIRONMENTAL AND EARTH SCIENCES	2575
Minerals and Ores	2575
Radioactivity Monitoring and Transport	2577
Atmosphere	2579
Soil	2582
Water	2582
Ecosystems and Food Cycles	2582
Radiometric Techniques	2583
Site Surveys	2583
Thermal Effluents	2583
Chemical Effluents	2584
INSTRUMENTATION	2585
Radiation Detection Instruments	2585
General Detectors and Monitors	2585
Radiation Dosimeters	2587
Nuclear Spectroscopic Instrumentation	2588
High Energy Physics Instrumentation	2589
Radiometric Instruments	2589
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	2590
Miscellaneous Instruments	2591
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	2592
Isotope Separation (Industrial)	2592
Isotopic Power Sources	2593
Radiation Sources	2593
Design and Fabrication	2593
Industrial Uses	2594
LIFE SCIENCES	2595
Radiation Effects on Biochemicals	2595
Radiation Effects on Cells	2596
Radiation Effects on Microorganisms	2598
Radiation Effects on Plants	2599
Radiation Effects on Animals	2600
Man	2600
Vertebrates	2611
Invertebrates	2615
Radionuclide Effects (Internal Source)	2616
Man	2616
Animals	2618
Nuclide Kinetics and Toxicology	2618
Man	2618
Animals	2619
Plants	2620
New Tracer Techniques	2620
MATERIALS	2628
Ceramics and Cermets	2628
Metals and Alloys	2638
Corrosion and Erosion	2639
Preparation and Fabrication	2646
Properties, Structure, and Phase Studies	2649
Radiation Effects	2668
Other Materials	2672
NUCLEAR MATERIALS AND WASTE MANAGEMENT	2680
Accountability and Safeguards	2680
Disposal and Storage	2680
Handling Equipment and Procedures	2681
Transportation	2681

TABLE OF CONTENTS (continued)

Category	Page
PARTICLE ACCELERATORS	2682
Design, Development, and Operation	2682
Auxiliaries and Components	2683
Ion Sources and Injection and Extraction Systems	2684
Ion Optics and Field Calculations	2686
Storage Rings	2686
Experimental Facilities	2686
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	2688
Cosmic Radiation	2688
Stars	2688
Quasi-Stellar, Radio, and X-Ray Sources	2692
Solar Phenomena	2694
Galaxies	2697
Cosmology	2699
Planetary Phenomena	2699
PHYSICS (ATMOSPHERIC)	2701
Auroral and Ionospheric Phenomena	2701
Effects of Nuclear Detonations	2707
Magnetospheric Phenomena	2707
PHYSICS (ATOMIC AND MOLECULAR)	2712
Beams and Their Reactions	2712
Atomic and Molecular Properties	2715
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	2716
Collision Phenomena	2717
Atomic Theory	2721
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	2722
PHYSICS (HIGH-ENERGY)	2726
Particle Interactions and Properties (Experimental)	2726
Electromagnetic	2726
Weak	2726
Strong (Baryon-induced)	2727
Strong (Meson-induced)	2730
Particle Interactions and Properties (Theoretical)	2731
General	2731
Electromagnetic	2734
Weak	2737
Strong (General)	2737
Strong (Baryon No. = 0)	2738
Strong (Baryon No. = 1)	2738
Strong (Baryon No. ≥ 2)	2739
Particle Invariance Principles and Symmetries	2741
General	2741
Applications (Electromagnetic and Weak)	2741
Applications (Strong)	2741
Scattering Theory	2741
PHYSICS (LOW-TEMPERATURE)	2743
Superconductivity	2743
PHYSICS (NUCLEAR)	2745
Neutron Interactions with Matter	2746
Nuclear Properties and Reactions, A < 5	2746

Category	Page
PHYSICS (NUCLEAR) (Cont'd.)	
Nuclear Properties and Reactions, 6 < A < 19	2747
Nuclear Properties and Reactions, 20 < A < 38	2750
Nuclear Properties and Reactions, 39 < A < 58	2752
Nuclear Properties and Reactions, 59 < A < 89	2753
Nuclear Properties and Reactions, 90 < A < 149	2754
Nuclear Properties and Reactions, 150 < A < 189	2757
Nuclear Properties and Reactions, 190 < A < 219	2758
Nuclear Properties and Reactions, A > 220	2759
Nuclear Theory	2763
PHYSICS (RADIATION AND SHIELDING)	2768
Radiation Physics	2768
Radiation Protection Standards	2770
Radiation Source Calibration and Standardization	2770
Shielding Calculations and Experiments	2770
PHYSICS (THEORETICAL)	2771
General	2771
Quantum Field Theories	2773
Gravitation and General Relativity	2777
REACTOR TECHNOLOGY AND REGULATION	2779
Power Reactors, Non-Breeding, BWR-Type	2780
Power Reactors, Non-Breeding, PWR-Type	2781
Power Reactors, Non-Breeding, Graphite Moderated	2782
Power Reactors, Non-Breeding, Otherwise Moderated	2786
Power Reactors, Breeding	2786
Research, Test, and Experimental Reactors	2792
Production and Materials Testing and Processing Reactors	2793
Propulsion and Package Reactors	2793
Reactor Safety and Environmental Aspects	2794
Reactor Theory and Calculation	2801
Reactor Components and Accessories	2803
Reactor Fuels	2805
Reactor Control Systems	2807
Nuclear Power Plant Economics	2807
Reactor Fuel Cycle Economics	2807
Reactor Licensing and Regulation	2808
GENERAL AND MISCELLANEOUS	2813
Information Handling	2813
Law	2813
Management	2813
Mathematics and Computers	2813
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-15
SUBJECT INDEX	INDEX-67
REPORT NUMBER INDEX	INDEX-192

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Assistant Editor
Lee M. Thompson

Associate Editors
M. Catherine Grissom
Robert C. Kelly
Sidney F. Lanier
Henry D. Raleigh
Charles E. Stuber

Report Evaluators
John H. Mitchell
Mary H. Newman
Ted Redmon

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Dora H. Moneyhun

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Information Specialists
P. Martin Alexander
Dianna D. Altom
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Stanley D. Frey
Darrell O. Galde
Martha W. Gerrard
Barbara J. Glenn
Everett J. Hoffman
Carolyn D. Houston
Lynda H. Kern
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Betty L. McDowell
Lorne T. Newman
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Stanley J. Rimshaw
Jessie W. Rushing
Robert W. Rutkowski
Francis L. Sachs
Lila B. Smith
Polly C. Summers
George H. Thoeming
Helen L. Ward
Lawrence T. Whitehead
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Noboru Kawakami

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

Volume 33, Number 11 June 15, 1976

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 26875, 28036, 28202, 28204, and 28207–28209.

25338 (UCID-15644-75-3) GENERAL CHEMISTRY DIVISION QUARTERLY REPORT, JULY–SEPTEMBER 1975. Harrar, J. E. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Nov 1975. Contract W-7405-Eng-48. 59p. Dep. NTIS $5.45.

Analytical research and development for the Whitney Programs include the following studies: computer automation of the Cary Model 171 spectrophotometer; feasibility of a portable microwave-spectrometer analyzer for chemical contaminants in air; polarized x-ray source for energy-dispersive x-ray fluorescence spectrometry; lasers for analytical chemistry; ion-cyclotron-resonance mass spectrometer; time-resolved spectrophosphorimetry; x-ray photoelectron spectrometry (ESCA); automation of the Hewlett-Packard model 5950A ESCA spectrometer; system for determining tritium in solid materials; separation of molecular species by radiation pressure; examination of bulk versus surface decomposition in various TATB-binder formulations; study of a discolored TATB, utilizing ESCA spectrometry, scanning electron microscopy, and an electron microprobe; measurement of the detection limit for surface analysis by 1.5-MeV alpha-particle backscattering; curium spectroscopy; semimicrodetermination of hydroxyl and amino groups with pyromellitic dianhydride (PMDA); determination of microgram amounts of chloride by potentiometric titration; and, analysis of trace metals in water. Other studies include: laser spectroscopy of atomic uranium; simulation modeling of mixed-oxide fuel-rod fabrication plants; computation of simulated NMR spectra; chlorine-35 NMR studies of anion-binding sites in enzymes; automation of a mass spectrometer for the National Center for Toxicological Research (NCTR); and automation of the Davies-Gray/New Brunswick Laboratory Method for the determination of uranium. (JGB)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 25953 and 26580.

25339 (AD/A-005218) COMPUTER PROGRAMS FOR QUANTITY DETERMINATION IN NEUTRON ACTIVATION ANALYSIS. Final Report. Antal, J. J.; Warnas, A. A. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Dec 1974. 72p. (AMMRC-TR-74-33). NTIS $4.25.

This report describes and lists several programs written in PAL III assembly language for the PDP-8 series of minicomputers to compute the quantity of an unknown element as determined by the AMMRC 14-MeV neutron activation analysis system. A complete determination of the error in the quantity of the unknown element is made in the program and is described here. (GRA)

25340 (AD/A-007106) CONTRIBUTION TO THE CHEMISTRY OF ANTARCTIC SNOW: TRACE ELEMENT DETERMINATION BY NEUTRON ACTIVATION. Echevin, M. (Centre National de la Recherche Scientifique, 38–Grenoble (France). Lab. de Glaciologie). Jan 1975. Draft Translation of Centre National de la Recherche Scientifique, Grenoble. Laboratoire de Glaciologie. Publication (France), n139, 86p, 10 May 1971. 84p. NTIS $4.75.

Studies on impurities found in the polar snows, centering primarily on the Antarctic are described. The program was conducted along two avenues: spectrometric analysis of the atomic absorption of the elements, sodium, magnesium, calcium, potassium, manganese, and iron; and neutron actuation analysis of the elements, chlorine, sodium, and manganese. In order to obtain the largest possible quantity of data, these two studies were run in very close collaboration and both bear on the analysis of the same samples. Activation analysis procedures are discussed. (GRA)

25341 (BNWL-SA-5610) MULTIELEMENT CHARACTERIZATION OF ATMOSPHERIC POLLUTANTS BY X-RAY FLUORESCENCE ANALYSIS AND INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Rancitelli, L. A.; Tanner, T. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-1830. 41p. (CONF-760311-2). Dep. NTIS $4.00.

From symposium on the development of nuclear-based techniques; Vienna, Austria (15 Mar 1976).

The simultaneous measurement of a wide spectrum of elements in aerosols collected on air filters and in rainwater can yield information on the origin, transport, and removal of atmospheric pollutants. In order to determine the elemental content of these aerosols, a pair of highly sensitive, precise and complementing instrumental techniques, x-ray fluorescence and neutron activation analysis, have been developed and employed. Data are presented on the results of combined x-ray fluorescence and activation analysis of aerosols collected in a number of urban areas of the USA and from the 80th median sampling network in March 1972. From a comparison of these ratios in granite and diabase with those of filters placed in urban areas, it is evident that Zn, Se, Sb, Hg, and Pb levels have been increased by as much as several orders of magnitude. Al, Co, La, Fe, Eu, Sm, Tb, Ta, Hf, and Th appear to exist at levels compatible with an earth's crust origin. (auth)

25342 (CONF-751085-1) TECHNIQUES FOR CHARACTERIZATION OF PARTICULATE MATTER: NEUTRON ACTIVATION ANALYSIS, X-RAY PHOTOELECTRON SPECTROSCOPY: SCANNING ELECTRON MICROSCOPY. Hulett, L. D.; Dale, J. M.; Emery, J. F.; Lyon, W. S. Jr.; Fulkerson, W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 17p. Dep. NTIS $3.50.

From EPRI workshop on sampling analysis and monitoring of stack emissions; Dallas, Texas, United States of America (USA) (2 Oct 1975).

Three techniques for particulate matter analysis are discussed: (1) neutron activation, which is a method that samples the entire specimen, both surface and bulk; (2) electron spectroscopy for chemical analysis (ESCA), which samples particle surfaces only; and (3) scanning electron microscopy (SEM), which reveals particle size and morphology, and can be used to determine composition differences in individual particles. These three techniques can be combined to construct highly detailed characterizations of particulate matter specimens. It is shown that multielement analysis can be quickly done by neutron activation and that surface analysis and individual particle analysis obtained by ESCA and SEM, are very important supplementary information. (auth)

25343 MICROIMPURITIES IN QUARTZES OF THE ENISEI RIDGE FROM DATA OF NEUTRON ACTIVATION ANALYSIS. Bochkarev, B. N.; Zhavoronkov, V. Ya.; Kulikov, A. A. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geokhimiya; No. 1, 135-139(1975). (In Russian).

In order to determine a number of elements by neutron activa-

tion analysis with the use of semiconductor gamma-spectroscopy, analyses were carried out on a collection of vein-quartz samples of Enisei ridge. A 500 mg sample of powder quartz was irradiated in a polyethylene container over a period of 10 hours in the IRT-2000 reactor at a flux of 10^{13} neutrons/cm^2-sec along with calibration samples of gold. Fourteen days after irradiation, measurements were made on a germanium-lithium detector with a volume of 20.5 cm^3 from the French firm "SAIP" in combination with an AI-256 analyzer. The gamma-radiation spectra of the samples were counted over an energy interval from 200 to 1200 kev at ~40% geometry. A total of 1 to 10 min was expended on the measurement of each sample. The gamma spectra were deciphered by means of tables and atlases of gamma spectra. As a result of the measurements which were carried out, the samples were divided into two groups: (1) quartz ore characterized by a high gold content, and (2) barren samples. (tr-INIS)

25344 DETERMINATION OF TRACE OXYGEN IN GOLD–COPPER ALLOYS AND IN HIGH PURITY COPPER BY ^{4}He ACTIVATION ANALYSIS. Debefve, P. (Inst. of Electro- and Radiochemistry, Lausanne, Switzerland); Lerch, P.; Vandecasteele, C. Radiochem. Radioanal. Lett.; 24: No. 1, 51-58(15 Jan 1976).

The determination of trace oxygen in gold–copper alloys and in high-purity copper by activation analysis with 45-MeV ^{4}He-particles is described. The chemical separation of ^{18}F produced from oxygen consists of steam-distillation as fluorosilicic acid, followed, for the copper samples, by precipitation of the interfering gallium activities as the hydroxide and of the fluoride as lead fluorochloride. The thallium activities, formed from the gold, are precipitated as the iodide. (auth)

25345 HOMOGENIZED SAMPLING OF BONE AND OTHER BIOLOGICAL MATERIALS. Iyengar, G. V. (Inst. of Medicine Nuclear Research Center, Juelich, Ger.). Radiochem. Radioanal. Lett.; 24: No. 1, 35-42(15 Jan 1976).

NAA was used to check the homogeneity of bone pulverized in a teflon-lined metal ball mill at −196°C. The use of pure quartz to powder soft tissues, contamination control and the suitability of the method for routine use is also discussed. (auth)

25346 MULTIELEMENT DETERMINATION IN MARBLE FROM CARRARA AND LIMESTONE STANDARD KH BY NEUTRON ACTIVATION ANALYSIS. Braetter, P.; Lausch, J.; Roesick, U. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kernchemie und Reaktor). Z. Anal. Chem.; 275: No. 5, 359-363(Aug 1975). (In German)

1 fig.; 3 tabs.; 14 refs.

Instrumental neutron activation analysis combined with Ge(Li) γ spectrometry has been used to determine the concentrations of 22 elements in marble from Carrara. The material is shown to be suitable as a comparative multielement standard for the analysis of samples with low concentrations of the elements concerned. Analytical results obtained for 23 elements in the standard reference material limestone KH (distributed by the ZGI) are also given. To correct pile-up errors in measurements of short-lived radionuclides having high starting activities a numerical method was introduced. A comparison with the pulser-timing procedure has been carried out for the analysis of aluminium. Consistent results were obtained by both methods. (DE)

25347 DETERMINATION OF SELENIUM IN DRY ORGANIC MATERIAL BY THERMAL NEUTRON ACTIVATION AND EXTRACTION. Hoede, D.; Massee, R.; Das, H. A. (Research Reactor Center, Petten, Netherlands). Radiochem. Radioanal. Lett.; 23: No. 5-6, 379-384(19 Dec 1975).

A routine method for the determination of trace amounts of selenium in dry organic material is discussed. The procedure consists of thermal neutron activation of the sample to ^{75}Se (T = 120 d) and extraction of SeI_4 into CCl_4. The limit of the determination is ≅10 ng.g^{-1} for a sample weight of ≅500 mg. Results for standard kale powder are given. (auth)

25348 SELECTIVE ENRICHMENT OF TRACE ELEMENTS USING AN ANILINE–SULFUR RESIN. II. Preconcentration and Separation of Dissolved $Hg(NO_3)_2$ from CH_3HgCl. Kramer, H. J.; Neidhart, B. (Technische Hochschule, Darmstadt, Ger.). Radiochem. Radioanal. Lett.; 23: No. 5-6, 295-300(19 Dec 1975).

An aniline sulfur resin (ASH) was found to be an effective matrix for the selective preconcentration of dissolved $Hg(NO_3)_2$ from aqueous solutions in the presence of CH_3HgCl at ppM levels. The separation is possible because the distribution between the aqueous phase and the ASH matrix as a function of pH is different for the two compounds. This could be shown by tracer experiments using Hg-197 and Hg-203 labelled compounds. As there is also a separation from sodium and selenium, the trace analysis of dissolved $Hg(NO_3)_2$ as well as CH_3HgCl by nondestructive, instrumental neutron activation analysis (NAA) becomes possible. (auth)

25349 ASSESSMENT OF SOURCES OF MARITIME AEROSOLS BY NEUTRON ACTIVATION ANALYSIS. Yano, N.; Katsuragawa, H.; Maebashi, K. (Meteorological Research Inst., Tokyo (Japan)). J. Rech. Atmos.; 8: No. 3, 807-817(Jul 1974).

From international symposium on the chemistry of sea-air particulate exchange processes; Nice, France (4 Oct 1973).

Maritime aerosols were analyzed in order to assess the background pollution. The samples were collected aboard ship in the Pacific Ocean during August 1970. A cascade impactor was used for sampling giant and large particles. Each sample was analyzed by the method of instrumental neutron activation analysis. The elements determined are Na, Cl, Al, Mn, V, etc. The analysis shows that the greater part of the large particles ($0.08\ \mu < r < 0.8\ \mu$) accounted for by the following three sources: (1) seasalt particles, (2) soil and rock debris, (3) man-made particles. The chemical composition of the above sources is considered to be conservative. Under the above assumptions, a rough estimation of the man-made influences is made. The results show that the total mass of man-made particles, which are concentrated in submicron particles, are 4 and 9% of the total mass of maritime aerosols. (FR)

25350 STUDY OF THE ANALYTICAL METHOD BASED ON CHARGED PARTICLE EXCITATION OF ELEMENTS AND DETECTION ON THE CHARACTERISTIC X-RAYS. Poncet, Maryse; Engelmann, Charles (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service d'Analyses et d'Etudes en Chimie Nucleaire et Isotopique). Analusis; 3: No. 6, 283-290. (Jun 1975). (In French).

Preliminary results obtained by bombarding thick or thin targets with protons of energies below 1.5 MeV are presented. In the former case, curves representing x-ray emission versus proton energy (between 0.4 and 1.4 MeV) were determined for 12 elements (Al, Ti, V, Fe, Ni, Cu, Nb, Ag, Sn, W, Au, Pb). From these curves the variation in detection sensitivity with atomic number for a given energy was derived. For some elements (Cu, Ag, Sn, Pb), deposited in thin layers on an aluminium substrate, the x-ray emission was studied as a function of thickness at constant energy. The results show that the method may be used to determine elements of atomic number near 30, in thin layers at least 200 μg.cm^{-2} thick, with a detection limit which could reach a few 10^{-3} μg.cm^{-2}. (FR)

25351 NEUTRON ACTIVATION DETERMINATION OF HAFNIUM IN ZIRCONIUM IN THE CASE OF INTERFERENCE FROM FLUORINE. Ovechkin, V. V.; Panshin, A. Z.; Rudenko, V. A. Sov. At. Energy (Engl. Transl.); 38: No. 4, 334-336(Apr 1975).

Translated from At. Energ.; 38: No. 4, 261-263(Apr 1975).

The optimum conditions for the determination of Hf in Zr, using a 14-MeV neutron generator and a Ge(Li) detector-based gamma spectrometer, were determined for those cases where there is strong F interference. The geometry used (R = 9 cm) and the use of a sufficiently large detector effectively resolves the interferring 0.197 MeV peak from the 0.217 MeV peak of Hf. (JSR)

25352 NEUTRON ACTIVATION MEASUREMENT OF THE FLUORINE CONTENT IN URANIUM AND PLUTONIUM. Melent'ev, V. I.; Ovechkin, V. V. Sov. At. Energy (Engl. Transl.); 38: No. 4, 337-338(Apr 1975).

Translated from At. Energ.; 38: No. 4, 263-264(Apr 1975).

An analysis of the characteristics of the neutron reactions on fluorine and the apparatus γ spectrum of irradiated uranium and plutonium permits us to conclude that there are advantages in using the reaction $^{19}F(n,\alpha)^{16}N$. The recording of high-energy γ radiation of the isotope ^{16}N ($E_\gamma \approx 6$ MeV, $T_{1/2}$ = 7.35 sec) in the region where the yield of the delayed radiation of the fission products is already small, provides for the possibility of obtaining higher selectivity and reliability of the result of the analysis. An extremely convenient means of activation is the use of an isotopic source based on the Be(α,n) reaction, since for the average energy of the emitted neutrons (~5 MeV) the cross section of the $^{19}F(n,\alpha)$ reaction is comparatively large, while the yield of the competing reaction $^{16}O(n,p)^{16}N$ is negligible. (auth)

25353 USE OF FAST NEUTRONS AND A Ge(Li)-DETECTOR FOR DETERMINATION OF SILICON AND OXYGEN IN VARIOUS MATERIALS. Andreev, A. V.; Golubchikov, V. V. (Inst. of Rare Metal Industry, Moscow). Zh. Anal. Khim.; 30: No. 11, 2150-2157(Nov 1975). (In Russian).

A high-sensitive procedure has been worked out for determining silicon in various materials by using a neutron generator NG-150 and a Ge(Li)-detector. In the determination of less than $1\text{–}2 \cdot 10^{-4}$ mass percent of silicon, it is necessary to deduct a contribution of surface contaminations. The possibility has been shown of determining oxygen (the sensitivity of $1 \cdot 10^{-4}$ mass percent) by using a Ge(Li)-detector. (auth)

Chemical and Spectral Procedures

25354 (BNWL-SA-5594) RADIOCHEMICAL SPECTRAL ANALYSIS BY MAXIMUM LIKELIHOOD. Nicholson, W. L.; Stevens, D. L. Jr. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 26p. (CONF-751113-9). Dep. NTIS $4.00.

From 1st ERDA statistical symposium; Los Alamos, New Mexico, USA (3 Nov 1975).

The radiochemical spectral analysis problem is expressed mathematically. Maximum likelihood estimates are derived for the two situations of standard spectra well-known and standard spectra imprecise. The maximum likelihood method is applied to backward-scattered alpha particle analysis of lunar soil samples from the Surveyor V moonlander. The standard spectra are assumed known. (JSR)

25355 (INIS-mf-1699, pp 22-26) RARE EARTH TRACES IN MINERAL WATERS. Nevoral, V. [nd]. (In Czech).

From 7th seminar on methods of determination and on significance of trace elements in biological materials; Prague, Czechoslovakia (15 May 1973).

In proceedings of the 7th seminar on methods of determination and on significance of trace elements in biological materials. (Ceskoslovenska Spolecnost Chemicka pri Ceskoslovenske Akademii Zemedelskych Ved, Prague; Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Katedra Chemie a Zkouseni Potravin).

A photometric method is described of determining rare earths in mineral waters. Concentration and separation of the rare earths were effected using a chromatographic column filled with the DOWEX 50W cation exchanger. Xylenol orange in the presence of cetyl pyridinium bromide was used as a reagent. (INIS)

25356 (LA-6091) AUTOMATED SPECTROPHOTOMETER FOR PLUTONIUM AND URANIUM DETERMINATION. Jackson, D. D.; Hodgkins, D. J.; Hollen, R. M.; Rein, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-Eng-36. 76p. Dep. NTIS $6.00.

The automated spectrophotometer presented in this report is the first in a planned series of automated instruments for determining plutonium and uranium in nuclear fuel cycle materials. It has a throughput rate of 5 min per sample and uses a highly specific method of analysis for these elements. The range of plutonium and uranium measured is 0.5 to 14 mg and 1 to 14 mg, respectively, in 0.5 ml or less of solution with an option to pre-evaporate larger volumes. The precision of the measurements is about 0.02 mg standard deviation over the range corresponding to about 2 rel percent at the 1-mg level and 0.2 rel percent at the 10-mg level. The method of analysis involves the extraction of tetrapropylammonium plutonyl and uranyl trinitrate complexes into 2-nitropropane and the measurement of the optical absorbances in the organic phase at unique peak wavelengths. Various aspects of the chemistry associated with the method, including tolerances for metal and nonmetal impurities, are presented. The automated spectrophotometer features a turntable that rotates as many as 24 samples in tubes (made from precision-bore tubing) to a series of stations for the sequential chemical operations of reagent addition and phase mixing to effect extraction, and then to a station for the absorbance measurement. With this system, the complications of sample transfers and flow-through cells are avoided. The absorbance measurement system features highly stable interference filters and a microcomputer that controls the timing sequence and operation of the system components. Output is a paper tape printout of three numbers: a four-digit number proportional to the quantity of plutonium or uranium, a two-digit number that designates the position of the tube in the turntable, and a one-digit number that designates whether plutonium or uranium was determined. Details of the mechanical and electrical components of the instrument and of the hardware and software aspects of the computerized control system are provided.

25357 EFFECT OF RADIOLYSIS IN COULOMETRIC DETERMINATION OF ^{238}Pu. Simakin, G. A.; Timofeev, G. A.; Baklanova, P. F. Zh. Anal. Khim.; 30: No. 10, 1961-1963(Oct 1975). (In Russian).

The possibility has been shown of determining ^{238}Pu by automatic coulometric titration at an absorbed dose of α-radiation in the test solution of of not more than $2.0 \cdot 10^{18}$ eV/ml. The relative standard deviation is 2.0% in the determination of 50-200 μg. (auth)

25358 REACTIONS BETWEEN SULFORCHROM AND THE RARE EARTHS. Bol'shakova, E. G.; Chernova, R. K.; Martynova, L. Yu.; Petrova, G. S. (Saratov State Univ., USSR). Zh. Anal. Khim.; 30: No. 10, 1956-1960(Oct 1975). (In Russian).

The reactions between 3,3'-dimethyl-4-hydroxyfuchson-4'-(5,5'-dicarboxy-2'',4''-disulfonic acid as its diammonium salt (sulfochrom, SC) and the rare earths have been studied spectrophotometrically in the absence and in the presence of o-phenanthroline (Phen). Regions have been found for the existance of two-component and mixed complexes as dependent on the pH and the serial number of the rare earth. The slope analysis has shown that the molar ratio of the components in the mixed-ligand compound is M : SC : Phen = 1 : 2 : 2. A procedure is suggested of determining some elements of the yttrium subgroup in the presence of the cerium subgroup elements. (auth)

25359 DETERMINATION OF RARE EARTHS IN MINERAL RAW MATERIALS BY USING SOLVENT EXTRACTION SEPARATION OF MACROCOMPONENTS. Dolgorev, A. V.; Lysak, Ya. G. (Scientific-Research Inst. of Mining Chemical Raw Materials, Moscow). Zh. Anal. Khim.; 30: No. 10, 1951-1955(Oct 1975). (In Russian).

Optimal conditions have been examined for extraction separation of some macrocomponents from hydrochloric acid solutions of the rare earths. The rare earth losses have been estimated radiometrically. A procedure has been developed for spectrophotometric determination of the total content of the rare earths in mineral raw materials. The sensitivity is $2.5 \cdot 10^{-4}$% with an error of 2-12%. (auth)

25360 N-CINNAMOYL-N-TOLYLHYDROXYLAMINE FOR AMPEROMETRIC DETERMINATION OF SCANDIUM AND YTTRIUM. Gallai, Z. A.; Sheina, N. M.; Shvedene, N. V.; Oliferenko, G. L. (Moscow State Univ.). Zh. Anal. Khim.; 30: No. 10, 1947-1950(Oct 1975). (In Russian).

The voltammetric study has been made of oxidation of a new organic reagent N-cinnamoyl-n-tolylhydroxylamine (CTHA) at a graphite electrode. The possibility has been established of using the current of oxidizing CTHA for titration end point indication up to pH 8. Procedures have been developed of amperometric titration of small amounts of scandium and yttrium by using CTHA. The solubility of the complexes formed has been determined. Scandium has been determined in the presence of some foreign elements. It has been shown that lanthanum, niobium, and praseodymium do not interfere with the scandium determination by CTHA at a ratio of 1 : 10 and yttrium at a ratio of 1 : 4. (auth)

25361 SPECTROGRAPHIC DETERMINATION OF BERYLLIUM IN SOME ALUMINUM-BASED PRODUCTS. Zakhariya, A. N.; Dranitskaya, R. M.; Vidisheva, A. Ya. (Odessa State Univ.). Zh. Anal. Khim.; 30: No. 10, 1934-1937(Oct 1975). (In Russian).

A spectrographic method was developed for determining beryllium in aluminum-oxide-based samples prepared by chemical treatment of metallic aluminum, its alloys, mixtures of partially oxidized powdered aluminum and beryllium, and their salts. The method is based on spectrum excitation under the action of high-voltage condensed spark on briquettes consisted of a mixture of the oxides and graphite. The relative mean square deviation is 4% which is constant at beryllium levels from 0.002 to 07.5%. (auth)

25362 LUMINESCENCE DETERMINATION OF GADOLINIUM IN CITRATE COMPLEX SOLUTION. Zhikhareva, E. A.; Zelyukova, Yu. V.; Poluektov, N. S. (Odessa Labs. of the Inst. of General and Inorganic Chemistry). Zh. Anal. Khim.; 30: No. 10, 2039-2042(Oct 1975). (In Russian).

The luminescence of gadolinium in citrate complex solutions has been studied using excitation by a phosphoroscope with molybdenum electrodes. The effect of impurities of anionic and cationic nature on the intensity has been examined. The procedure developed has been applied to the analysis of yttrium oxide with a sensitivity of 0.1%.

25363 USE OF FLUORIDE SELECTIVE ELECTRODE FOR DETERMINATION OF FLUORINE IN PURE ZIRCONIUM. Privalova, M. M.; Tulina, M. D.; Sheyanova, E. M.; Borzova, N. M. (Physicoenergetic Inst., Obninsk, USSR). Zh. Anal. Khim.; 30: No. 10, 1984-1991(Oct 1975). (In Russian).

A method is described for determining fluorine traces in zirconium and its compounds. The method is based on distilling off the fluoride from a zirconium solution in H_2SO_4 followed by fluoride determination by a fluoride selective electrode. The relative standard deviation is 8.0 and 4.0% at fluorine levels of 0.0025 and 0.01% respectively. The sensitivity is $1 \cdot 10^{-4}$ per cent when a 1-g sample is used. (auth)

25364 METROTRACE AND BASIC ELEMENT DETERMINATION IN GERMANIUM-SELENIUM-TELLURIUM SYSTEMS. Fano, V.; Zanotti, L. (CNR, Parma, Italy). Mikrochim. Acta; 2: No. 4-5, 547-552(1975).

An analytical method has been designed for determination of microtraces of copper, cadmium, lead and zinc in germanium and in germanium, selenium and tellurium alloys. All the trace

elements were simultaneously determined by stripping voltammetry in a sodium chloride medium. The sample matrix was previously removed by a simple procedure requiring germanium extraction into carbon tetrachloride, and separation of selenium and tellurium by sulfur dioxide. In addition, a procedure for matrix component determination is described: germanium was precipitated with tannin and then ignited to the dioxide; selenium and tellurium were separated with sulfur dioxide at different acidity and determined as the elements. (auth)

25365 CONTRIBUTIONS TO THE ANALYSIS OF NUCLEAR RAW MATERIALS. IX. Atomic Absorption Spectrophotometric Determination of Copper in U_3O_8 and Yellow Cake Samples. Korkisch, J.; Steffan, I.; Grob, H. (Analytisches Institut der Universitat, Vienna). Mikrochim. Acta; 2: No. 4-5, 569-579 (1975). (In German).

A method is described for the separation of μg-amounts of copper from large amounts of uranium and of making the end-determination accessible by means of atomic absorption spectrophotometry. The separation of the copper from uranium and from other foreign ions present in the uranium matrix is brought about through adsorption of the copper on a column of the strongly basic anion exchanger Dowex 1, X8 from a mixture that consists of 90 vol.% methanol and 10 vol.% hydrobromic acid. After the adsorbed copper is eluted by means of 3M hydrochloric acid the copper is determined by the atomic absorption spectrophotometric method. The method was applied for the determination of copper in standard specimens of U_3O_8 (1 to 11 ppm Cu) and yellow cake (4 to 25 ppm Cu). (auth)

25366 CONTRIBUTIONS TO THE ANALYSIS OF NUCLEAR RAW MATERIALS. VIII. Atomic Absorption Spectrophotometric Determination of Lead in U_3O_8 and Yellow Cake Samples. Korkisch, J.; Grob, H. (Univ., Vienna). Mikrochim. Acta; 2: No. 4-5, 413-424(1975). (In German).

A procedure is described for the separation of μg quantities of lead from large amounts of uranium and for making accessible an end-determination by means of atomic absorption spectrophotometry. The separation of the lead from the uranium and from other foreign ions present in the uranium matrix is accomplished by adsorption on a column of the strongly basic anion exchanger Dowex 1, X8 from 2M hydrobromic acid. Following elution of the adsorbed lead by means of 6M hydrochloric acid, the lead is determined either by means of atomic absorption spectrophotometry or by spectrophotometry with employment of the dithizone method. The procedure was employed for the determination of lead in standard specimens of U_3O_8 (0.17 to 1.8 ppm Pb) and of Yellow Cake (7.8 to 88 ppm Pb). A good agreement of the results was attained in all cases. (auth)

25367 USE OF ALIZARIN AND ITS DERIVATIVES FOR THE DETERMINATION OF MOLYBDENUM. Krizan, M.; Nozaki, J. (Pontificia Universidade Catolica, Rio de Janeiro). Mikrochim. Acta; 2: No. 4-5, 435-441(1975). (In German).

A method has been developed for the determination of molybdenum with alizarin complexone and compared with other alizarin derivatives. In alcohol-water, and at pH = 5, and an excess of alizarin complexone, there is produced a complex, in the ratio of 1 : 1, which absorbs at 480 nm. The molar extinction coefficient is 4.689 and the $K_f = 2{,}51 \cdot 10^5$. The method was employed in the analysis of a specimen of a steel, whereby the interfering elements were separated off by paper chromatographic means. (auth)

25368 CHELATOMETRIC TITRATIONS IN ETHANOLAMINE WITH CATALYTIC-THERMOMETRIC ENDPOINT INDICATION. Kiss, T. F. A. (Univ. Freiburg, Ger.). Mikrochim. Acta; 2: No. 4-5, 471-476(1975). (In German).

The advantages of the employment of an ethanolamine medium for the carrying-out of chelatometric titrations with catalytic-thermometric endpoint indication are shown. The direct titration of DCTA, EDTA, and NTA with manganese(II) sulfate, the inverse titration of manganese(II) against these chelate-formers, and likewise the determination of a series of metal ions (alkaline earths, Zn^{2+}, Cd^{2+}, Mn^{2+}, Pb^{2+}, Hg^{2+}, Tl^{3+}, Al^{3+}, Ga^{4+}, Cu^{2+}, In^{3+}, Th^{4+}) by backtitration of an excess of DCTA or EDTA with manganese(II)-standard solution is described. The catalytic decomposition of hydrogen peroxide by manganese(II) may be employed more effectively as indicator reaction in ethanolamine medium than in water or in dimethylsulfoxide. The above-named ions can be determined in milligram- and microgram-range with satisfactory accuracy. (auth)

25369 INVESTIGATION OF THE CONDITIONS OF DIRECT AMPEROMETRIC DETERMINATION OF CERIUM WITH METHYLDIMERCAPTOTHIOPYRONE. Usatenko, Yu. I.; D'yachenko, L. F.; Kravtsova, V. I. (Dnepropetrovsk Chemicotechnological Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 6, 791-792 (Jun 1975).

Translated from Zavod. Lab.; 41: No. 6, 645-646(Jun 1975).

The interaction of methyldimercaptothiopyrone with Ce(IV) was used in an amperometric titration carried out in strongly acid medium. The real redox potentials of solutions of Ce(IV) and the reagent were determined in various media to ascertain the nature of the interaction. A method was developed for the amperometric titration of cerium in industrial samples – cash irons and steels. (LK)

25370 EXTRACTION, SEPARATION, AND DETERMINATION OF THORIUM AND SCANDIUM IN A NITRATE SYSTEM WITH DIANTIPYRYLMETHANES. Petrov, B. I.; Zhivopistsev, V. P.; Degtev, M. I.; Pyatosin, L. P. (Gorky Perm State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 6, 805-807(Jun 1975).

Translated from Zavod. Lab.; 41: No. 6, 655-657(Jun 1975).

The influence of the acidity of the medium, the concentration of nitrate ions, and the nature of the reagent on the extraction of thorium and scandium were studied. The extractions were carried out with 0.1 M solutions of thorium and scandium nitrates, and 0.125 M solutions of DAM, MDAM, PDAM, and HDAM in chloroform. Scandium is extracted well only by DAM; thorium is extracted best by PDAM. For separation of thorium and scandium, the former is extracted from 6 N HNO_3 with PDAM, the excess acid is neutralized with a solution of alkali or ammonia to 0.5 N HNO_3, and the scandium is extracted with DAM. After separation thorium and scandium are determined complexometrically. (LK)

25371 DETERMINATION OF MICROQUANTITIES OF CHROMIUM IN INCREASED PURITY COMPOUNDS OF THE RARE EARTH METALS. Goryanskaya, G. P.; Kirillova, Z. P.; Metisov, Yu. I.; Petrova, E. I.; Skripkin, G. S. (State Scientific Research and Planning Inst. of the Rare Metals Industry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 6, 813-814(Jun 1975).

Translated from Zavod. Lab.; 41: No. 6, 662-663(Jun 1975).

A colorimetric method for analysis of chromium in rare earths with increased sensitivity is reported. The rare earth compound is dissolved in nitric acid, and the excess nitric acid is removed by evaporation. Interfering impurities (Fe and Cu) were removed by selective reextraction of the complex compound of chromium with diphenylcarbazide. The sensitivity of the analysis of rare earths and their oxides, estimated according to the 25 criterion, where 5 is the standard deviation of the results of the determination of additives to the purest rare earth bases, is 5×10^{-6}%. The amount of the chromium impurity is 0.5×10^{-5} to 5×10^{-5}%. (LK)

25372 DFS-10M QUANTOMETER ANALYSIS ERROR FOR STEELS. Buyanov, N. V. (Bardin Central Ferrous Metallurgy Research Inst., Moscow). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 6, 831-832(Jun 1975).

Translated from Zavod. Lab.; 41: No. 6, 676-678(Jun 1975).

The standard deviation S was determined for 11 elements in the following concentration ranges: 0.01–1.00% Al; 0.02–2.00% V; 0.03–4.00% W; 0.02–1.70% Si; 0.1–2.00% Mn; 0.01–1.00% Cu; 0.01–2.60% Mo; 0.01–2.00% Ni; 0.02–1.50% Nb; 0.05–1.00% Ti; and 0.01–2.00% Cr. The range for each element was divided into four or five intervals. (LK)

25373 CHEMICOSPECTRAL DETERMINATION OF IMPURITIES IN LANTHANUM AND ITS OXIDE. Slyusareva, R. L.; Kondrat'eva, L. I. Ind. Lab. (USSR) (Engl. Transl.); 41: No. 6, 846-847(Jun 1975).

Translated from Zavod. Lab.; 41: No. 6, 689-690(Jun 1975).

A chemicospectral method of determining Al, V, Ti, Mo, Zi, Hf, Nb, Ta, and W (involatile impurities) in lanthanum and its oxide was developed. Ammonia was used to precipitate lanthanum as the hydroxide; the impurities coprecipitate almost quantitatively with the lanthanum hydroxide deposit. The spectral determination of the impurities was carried out by the complete evaporation of the samples in a dc arc between carbon electrodes. (LK)

25374 SPECTRAL DETERMINATION OF MOLYBDENUM IN ORES AND PRODUCTS OF THEIR PROCESSING. Zhupieva, E. P. (Leninogorsk Polymetallic Combine, USSR). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 6, 852(Jun 1975).

Translated from Zavod. Lab.; 41: No. 6, 692-693(Jun 1975).

A DFS-8 spectrograph, a DG-2 arc generator as the excitation source, carbon electrodes (C-2, C-3), and spectral type II photographic plates were used in the spectral determination of molybdenum in ores and their transformation products. Determined concentrations are in the range of 0.001–0.10% Mo; relative error is ± 10%. (LK)

25375 DIRECT SPECTRAL METHOD OF DETERMINING TANTALUM AND TUNGSTEN IN ZIRCONIUM DIOXIDE. Patrikeeva, N. A. (Voroshilovgradsk Mechanical Engineering Inst., USSR). Ind. Lab. (USSR) (Eng. Transl.); 41: No. 6, 853(Jun 1975).

Translated from Zavod. Lab.; 41: No. 6, 693(Jun 1975).

A direct spectral method for determination of Ta and W is

based on the assumption that they form covalent compounds with halide ions in a highly oxidized state which are more volatile in comparison with ions. Gallium and sodium fluorides and sodium chlorides were used as the support. (LK)

25376 SPECTRAL DETERMINATION OF BORON AND CADMIUM IN ZIRCONIUM DIOXIDE CONTAINING IRON, CHROMIUM, AND NICKEL OXIDES. Anisimova, Z. A.; Patrikeeva, N. A. (Voroshilovgradsk Mechanical Engineering Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 6, 854(Jun 1975).

Translated from Zavod. Lab.; 41: No. 6, 693-694(Jun 1975).

The principle of the method consists of fractional evaporation of boron and cadmium from figured carbon electrodes in the presence of large concentrations of sodium fluoride. The increased concentration of the latter (10-15%) in the analyzed weight provides for transformation of boron carbide, which can be formed in the electrode crater, to the more volatile compound, boron fluoride. In this case distillation of cadmium improves, probably because of formation of volatile cadmium fluoride. (LK)

25377 THIN INSULATING LAYERS ANALYSIS WITH CASTAING-SLODZIAN ION ANALYSER. Blanchard, B.; Brun, J. C.; Hilleret, N. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service de Chimie Analytique). Analusis; 3: No. 6, 312-316(Jun 1975). (In French).

The methods employed to overcome the difficulties encountered in the study of thin insulating layers are described; modification of the sample voltage to compensate the surface charge; presence of oxygen near the sample which allows the same rate of ionization for the oxide and the metal; crater shape adequate to reduce redeposition phenomena; bombardment by neutral particles to avoid the migration of some impurities under the influence of electric fields created by electric charges on the surface. (FR)

25378 EXTRACTION-ATOMIC-ABSORPTION DETERMINATION OF NIOBIUM AND TANTALUM IN TECHNOLOGICAL AND SPENT SOLUTIONS. Kuchucov, V. A.; Renard, I. M. Zh. Anal. Khim.; 30: No. 11, 2172-2176(Nov 1975). (In Russian).

A method has been developed of atomic absorption determination of niobium and tantalum in washing waters, mother and spent solution of tantalum-niobium production by using their preliminary concentration by extraction with methyl isobutyl ketone. Microamounts of niobium and tantalum are quantitatively extracted from solutions 2 M in HF and 4 M in H_2SO_4. The removal of mutual effect of niobium and tantalum is achieved by buffering original solutions by large amounts of niobium in tantalum determinations and by large amounts of tantalum in niobium determinations. (auth)

25379 USE OF ION-SELECTIVE ELECTRODES FOR DETERMINATION OF FLUORIDES, CHLORIDES, AND IODIDES IN NATURAL WATER. Zeinalova, E. A.; Senyavin, M. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 11, 2207-2212(Nov 1975). (In Russian).

Conditions have been examined for determination of fluorides, chlorides, and iodides in natural water by using membrane ion-selective electrodes. Ranges of pH have been chosen for determining fluorides (5–9), chlorides and iodides (1–12). Recommendations are given for removal of the effect of acetate and citrate ions of the buffer solution by adding 0.005 M solution of a lanthanum salt. It has been shown that macro- and microcomponents of natural water do not interfere with determining chlorides. Some microcomponents (e.g., aluminium) interfere with determining fluorides. Microamounts of Fe(III), Cu(II), Pb(II), Zn(II) interfere with determining iodides due to formation of slightly soluble compounds. EDTA is suggested to use for removal of the effect of microcomponents. (auth)

25380 DETERMINATION OF PRASEODYMIUM IN ULTRAVIOLET REGION OF SPECTRUM BY USING ITS COMPLEX WITH DIETHYLENETRIAMINEPENTAACETIC ACID. Kirillov, A. I.; Turkina, L. A.; Vlasov, N. A. (Irkutsk State Univ., USSR). Zh. Anal. Khim.; 30: No. 11, 2262-2264(Nov 1975). (In Russian).

It has been shown spectrophotometrically that praseodymium forms a complex with diethylenetriaminepentaacteic acid in a ratio of 1:1 over the pH range 3–10. The absorption maximum for the complex is located at 214 nm. The $PrOH^{2+}$ ion is involved in the complex formation which replaces two protons from a reagent molecule. A spectrophotometric procedure has been worked out of determining praseodymium in a mixture of rare earth oxides. (auth)

25381 ANALYTICAL USE OF ION ASSOCIATES OF SCANDIUM WITH SALICYLIC OR 2-PHENYLQUINOLINE-4-CARBOXYLIC ACID AND RHODAMINE B. Kononenko, L. I.; Bel'tyukova, S. V.; Drobyazko, V. N.; Poluektov, N. S. (Odessa Labs. of the Inst. of General and Inorganic Chemistry). Zh. Anal. Khim.; 30: No. 9, 1716-1719(Sep 1975). (In Russian).

Scandium forms ion associates with salicylic or 2-phenylquinoline-4-carboxylic acid and rhodamine B; benzene solutions of the associates can luminesce. Optimal conditions for the complex formation have been determined. The possibility has been shown of luminescence determination of scandium in the presence of rare earths. (auth)

25382 CATALYTIC WAVE OF PERIODATE IONS AT A PLATINUM VIBRATING ELECTRODE IN THE PRESENCE OF RUTHENIUM. Rysev, A. P.; Yakshinskii, A. I.; Alekseeva, I. I. (Moscow Inst. of Fine Chemical Tech.). Zh. Anal. Khim.; 30: No. 9, 1750-1756(Sep 1975). (In Russian).

A catalytic wave has been observed in KIO_4 solutions (sulfuric acid medium) at a platinum vibrating electrode in the presence of ruthenium. A possible mechanism of appearance of the catalytic current is discussed and the possibility has been shown of using the catalytic wave for determination of ruthenium. (auth)

25383 CHOICE OF A STANDARD IN PRECISE MASS SPECTROMETRIC DETERMINATIONS OF ISOTOPIC COMPOSITION BY THE METHOD OF COMPARISON. Doil'nitsyn, E. F.; Zyuzin, V. I.; Pertseva, A. P. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Zh. Anal. Khim.; 30: No. 11, 2106-2111(Nov 1975). (In Russian).

In precise determinations of isotopic composition, it is enough to have one standard reliably checked by an international standard or have a known isotope composition determined with an accuracy which is compatible with the aim of the measurements. In measurements by the method of comparison suggested, the difference between isotopic ratios for the standard and the sample does not demand rigid conditions. This difference should be as large as possible but within limits of the recorder scale to obtain minimum relative error. The most sensitive scale should be used for the measurements as the precision is determined by the recording system sensitivity, parameters of the compensating circuit and the number of measurements. The recorder scale should be largest which lays within the given measurement scale. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 26038, 26040, 26069, and 26879.

25384 (AED-CONF-75-404-007) PYROLYTIC METHOD OF TRITIUM DETECTION IN A GRAPHITE MATRIX. Stoeppler, M.; Spriestersbach, U.; May, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Physikalische Chemie). 1975. 13p. (In German). INIS.

From general meeting of the Gesellschaft Deutscher Chemiker; Koeln, F. R. Germany (8 Sep 1975).

4 figs.; 4 refs.

The method described below can be used for absolute measurements of the tritium content in the graphite moderator of gas-cooled high-temperature reactors. The graphite specimen is pyrolysed at a temperature of about 800°C in a specially developed quartz apparatus, and the combustion gases are led into phosphorus pentoxide absorption tube across a quartz wool filter which retains solid fission and activation products. The contents of this tube are dissolved in H_2O, and the tritium content of the solution is determined by scintillation measurements. Factors influencing the method as well as its reproducibility and yield are discussed. Decontamination factors of $<10^4$ are reacted for the fission products. At very high concentrations of fission products, corrections can be made by γ-spectrometry or Cherenkov measurements. (DE)

25385 (BNWL-SA-5480) RECENT EXPERIENCE IN THE ANALYSIS OF POSTMORTEM SAMPLES FOR PLUTONIUM. Thomas, V. W. Jr.; Kirby, L. J.; Nelson, I. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 3 Sep 1975. Contract E(45-1)-1830. 21p. (CONF-751095-1). Dep. NTIS $4.50.

From 21st annual bioassay conference; San Francisco, California, United States of America (USA) (8 Oct 1975).

Procedures are described for isotopic analysis of large autopsy tissue samples for $^{239,240}Pu$ and ^{238}Pu at Hanford. Internal tracers (^{242}Pu, ^{236}Pu) are presently used to measure radiochemical recovery to an accuracy of +–5 percent. Sample sizes may be up to at least 400g for soft tissues and up to 50g for bone with recoveries of 70 +– 30 percent. Some critical points of the procedure, problems and their solutions are discussed. (auth)

25386 (UCLA-12-1047) DETERMINATION OF ^{238}Pu AND ^{242}Cm IN AQUEOUS SOLID EXTRACTS. Wood, R. A.; Nishita, H.; Hamilton, M.; Wakakuwa, S. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1976. Contract E(04-1)-GEN-12. 10p. Dep. NTIS $3.50.

A method is described for the quantitative determination of ^{238}Pu and ^{242}Cm contained in aqueous soil extracts. The organic matter is destroyed using standard wet ashing techniques. The

87.8-h ^{238}Pu and 163-d ^{242}Cm are isolated by co-extraction with iron and purified using cation exchange techniques. The final eluate is evaporated to dryness on stainless steel planchets and counted using an alpha spectrometer system in conjunction with a silicon surface barrier detector. Greater than 98 percent recovery of ^{238}Pu and ^{242}Cm was obtained from ammonium acetate and sodium hydroxide–nitric acid extracts of traced soil. The primary advantages of this method are: (1) secondary tracers are not needed for the determination of chemical yields, and (2) expensive and time-consuming electrodeposition techniques are not required for final sample mounting. (auth)

25387 MICRO-DETERMINATION OF ZIRCONIUM-HAFNIUM RATIOS IN ZIRCONS BY PROTON INDUCED X-RAY EMISSION. Van Grieken, R. E.; Johansson, T. B.; Winchester, J. W.; Odom, L. A. (Florida State Univ., Tallahassee (USA). Oceanography Dept.; Florida State Univ., Tallahassee (USA). Dept. of Geology). Z. Anal. Chem.; 275: No. 5, 343-348(Aug 1975).

3 figs.; 3 tabs.; 14 refs.

The zirconium/hafnium ratios of zircons are determined using proton induced x-ray emission. Submilligram samples, imbedded in a starch layer and deposited on a 50 $\mu g/cm^2$ polystyrene carrier, are irradiated for 10-20 min with a 5 nA beam of 3.7 MeV protons, while the Hf-L(β) and Zr-K(α) x rays are counted with a Si(Li) detector. The standard deviation per analysis is in the 3 to 6% range. Only few interferences are possible. To eliminate errors due to absorption effects the zircon layer thickness should be above 40 μm or reproducibly thin samples should be employed. Measuring the Hf-L(β)/Hf-L(α) ratio for samples and standards might provide a practical check for the absence of absorption errors. The sensitivity is so favorable that, in practice, the minimal sample size is only limited by the minimal amount that can be handled properly. (DE)

25388 GAMMA-SPECTROMETRIC DETERMINATION OF THE FISSILE AND FERTILE MATERIAL DISTRIBUTIONS IN FUEL RODS FOR HTR BLOCK FUEL ELEMENTS. Lang, H.; Meixner, C. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Brennelement- und Bestrahlungstechnologie). Kerntechnik; 17: No. 8, 359-364(Aug 1975). (In German, English)

6 figs.; 5 refs.

The relative axial fissile and fertile material distributions in fuel rods for block-shaped HTR fuel elements can be determined nondestructively by γ spectrometry of the spontaneous radiation of U 235 und Th 232. This report describes the measuring method and the automated measuring facility. (DE)

25389 THORIUM AND URANIUM ANALYSIS IN ROCK SAMPLES BY γ-SPECTROSCOPY USING COMBINED MEASUREMENTS WITH Be(Li) AND NaI(Tl) DETECTORS. Pires de Matos, A.; Baptista, J. G. (Laboratorio di Fisica e Engenharia Nucleares, Sacavem, Portugal). Radiochem. Radioanal. Lett.; 23: No. 5-6, 337-341(19 Dec 1975).

A quick method for the simultaneous determination of U and Th in rock samples was studied combining measurements with Ge(Li) and NaI(Tl) detectors. By using only a Ge(Li) detector, the ratio of Th and U content could be determined independently of the geometry and solid composition of the sample. (auth)

25390 DETERMINING COMPOSITION OF A SUBSTANCE BY THE USE OF BOTH REFLECTED AND TRANSMITTED RADIATION. Teller, S. (to Isotopcentralen). US Patent 3,928,765. 23 Dec 1975. Priority date 22 Nov 1972, Denmark. 6p.

An apparatus for the determination of the content of sulfur in hydrocarbon fuels comprising a primary and a secondary source of gamma- or x-rays arranged on opposite sides of a test zone and a detector connected to a recording device for detecting and recording backscattered and transmitted rays emitted by the radiation sources is described. (auth)

25391 SIMULTANEOUS DETERMINATION OF PAIRS OF ELEMENTS WITH SIMILAR CHEMICAL PROPERTIES BY THE ISOTOPE-DILUTION METHOD USING SUBSTOICHIOMETRIC SEPARATION. Atrashkevich, V. V.; Bilimovich, G. N.; Alimarin, I. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 11, 2098-2101(Nov 1975). (In Russian).

The possibility has been shown of simultaneous determination of pairs of elements with similar chemical properties taking as examples the EDTA–yttrium and neodymium–thenoyltrifluoroacetone (TTA) system and the diethylenetriaminepentaacetic acid–yttrium and neodymium–TTA system by using a substoichiometric variant of the isotope-dilution method. The method is based on difference in distribution coefficients of the elements studied between organic and aqueous phase for two systems involving substoichiometric amounts of different complexones. It is also necessary to have a linear correlation between the change of the distribution coefficient of one element and changing concentration of another.

25392 SUBSTOICHIOMETRIC SEPARATION OF ZIRCONIUM IN THE PRESENCE OF TWO CHELATE-FORMING REAGENTS BY ISOTOPE DILUTION ANALYSIS. Akolsina, L. D.; Bilimovich, G. N.; Alimarin, I. P.; Churkina, N. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 9, 1743-1749(Sep 1975). (In Russian).

The possibility has been examined of using solvent extraction to separate excess (oversubstoichiometric) amount of zirconium in respect to complexones (EDTA, DTPA) present in the aqueous solution. Thenoyltrifluoroacetone (TTA), N-benzoylphenylhydroxylamine (BPHA) and 1-phenyl-3-methyl-4-benzoylpyrazolone-5 (PMBP) in various solvents have been studied as the second chelate-forming reagent. The extractants studied may be arranged in a series, TTA < BPHA < PMBP, according to the plateau length which corresponds to a region where the competing reactions are in equilibrium. It has been shown that the last two extractants are most promising for the determination of zirconium in its 10^{-4}–10^{-7} M solutions. The method of isotope dilution analysis in the presence of two chelate-forming reagents (EDTA and PMBP) has been used to analyze metallic titanium samples. (auth)

25393 SEARCH FOR SPONTANEOUSLY FISSILE EMITTERS IN THERMAL BRINES FOR THE CHELEKEN PENINSULA. Chuburkov, Yu. T.; Maslov, O. D.; Lebedev, L. M.; Shatalov, V. V.; Smirnov, V. Yu.; Chuburkova, I. I.; Petrov, D. V.; Makedonskaya, A. I. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 808-812(1974).

Translated from Radiokhimiya; 16: No. 6, 827-832(1974).

Experiments are described that were performed in an attempt to identify and/or isolate the source of radioactivity noted in samples of subterranean brines from the Cheleken Peninsula. The possibility that the radioactivity was due to uranium was eliminated, and the possibility that the radioactivity is due to a superheavy element(s) (Z = 112 - 115) is proposed. However, attempts to isolate or positively identify this element(s) by chemical enrichment, ion exchange sorption of metals, or other methods based on the prediction of elemental properties from the periodicity of the periodic table were unsuccessful. Proposal of future studies to be made on the subterranean waters emphasize that these reported studies on waters at the outlets of boreholes have not eliminated the possibility of preferential impoverishment of the water of heavy metals prior to analysis. (BLM)

25394 LOW LEVEL COUNTING TECHNIQUES. Oeschger, H.; Wahlen, M. (Univ., Bern). Annu. Rev. Nucl. Sci.; 25: 423-463 (1975).

The most common detector systems are summarized and the parameters important to their application, such as sensitivity and background count rates are discussed. LLC techniques are also compared to other analytical procedures. A representative sample of the spectrum of applications of LLC in various scientific disciplines is given. Several typical LLC systems are reviewed, together with some of the results obtained. Finally, an overview is presented of future possibilities for applications of low level counting techniques. 6 tables, 1 figure, 80 references. (auth)

Separation Procedures

Refer also to abstracts 25539 and 25556.

25395 (GSI-tr-5/75) CHEMICAL SEPARATION OF NILSBOHRIUM AS EKA-TANTALUM IN THE FORM OF DEHYDRATED BROMIDE. Belov, V. Z.; Zvarova, T. S.; Shalaevsky, M. R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Jun 1975. (JINR-P-12). 11p. (In German). INIS.

4 figs.; 1 tab.; 6 refs. Translation from the Russian report. Available from ZAED.

The behavior of radioactive recoil atoms of niobium, tantalum, hafnium, and other elements from nuclear reaction with heavy ions on the cyclotron when stopping in a mixture of Br_2 and BBr_3 vapors and with continuous transfer to a thermochromatographic nickel column together with the bromating carrier gas was investigated. It was found that niobium and tantalum bromide form sharp adsorption zones in the column at the same place and are separated from hafnium. The time which the niobium atoms need from the target adsorption in the column is 0.1–0.2 sec. The method is thus suitable for investigating the properties of the nilsbohrium bromide using the known spontaneous fissioning 2-sec isotope of the element 105. (DE)

25396 NEW PROCESS FOR AMERICIUM PURIFICATION. Proctor, S. G. (Dow Chemical USA, Golden, CO). J. Less-Common Met.; 44: 195-199(Jan 1976).

A method of purifying americium has been developed which makes use of the solubility of the americyl ion (AmO_2^{++}) in the presence of fluoride ion. This precipitation process was primarily designed for the removal of rare-earth impurities; however, in addition, purification from most common elemental impurities can be expected. The process developed has been used to produce AmO_2 with no detectable rare-earth impurities and only 600 ppM total impurities. (auth)

25397 RECOVERY OF FISSION PRODUCTS FROM WASTE SOLUTIONS UTILIZING CONTROLLED CATHODIC POTENTIAL ELECTROLYSIS. Carlin, W. W.; Darlington, W. B. (to PPG Industries, Inc.). US Patent 3,922,231. 25 Nov 1975. Filed date 24 Nov 1972. 20p.

Fission products, e.g., palladium, rhodium and technetium, are recovered from aqueous waste solutions thereof, e.g., aged Purex alkaline waste solutions. The metal values from the waste solutions are extracted by ion exchange techniques. The metals adsorbed by the ion exchange resin are eluted and selectively recovered by controlled cathodic potential electrolysis. The metal values deposited on the cathode are recovered and, if desired, further purified. (Official Gazette)

25398 CONDITIONS FOR ELECTRODEPOSITION OF TELLURIUM ON DIFFERENT GRAPHITE ELECTRODES BY INVERSION VOLTAMMETRY. Neiman, E. Ya.; Figelson, Yu. A.; Yakovleva, V. G. (Scientific-Research and Design Inst. of Alloys and Non-ferrous Metal Working, Moscow). Zh. Anal. Khim.; 30: No. 10, 1977-1983(Oct 1975). (In Russian).

The electrochemical deposition and ionization of tellurium and its deposition together with mercury and cadmium have been studied by inversion voltammetry using: electrodes made of various graphite materials. The advantage has been shown of determining tellurium from ionization currents of its binary deposits with mercury. The possibility has been investigated of simultaneous determination of cadmium and tellurium. (auth)

25399 COEXTRACTION OF SULFATE AND PHOSPHATE IONS WITH NAPHTHENATES. Makov, N. N.; Malyshev, V. K. Zh. Anal. Khim.; 30: No. 10, 2042-2045(Oct 1975). (In Russian).

Sulfate and phosphate ions are not extracted with naphthenic acids in the absence of multicharged cations. However, in the presence of naphthenic acids, sulfate and phosphate ions are coextracted with Zr, FE(III), In, Al, Ce(III), Y, Cr(III), Cd, Ni, Mn(II), Co(II). The pH_{50} value for phosphate ions increases in the order: Fe(III) < Bi < In < Pb(II) < La < Ce(III) < Eu < Yb < Pb < Cd < Mn(III) < Co(II). The extraction curves for the anions studied and for the corresponding naphthenates are situated in a close pH range. The extraction increases with increasing the extractant and extracted cation concentrations and decreases with increasing the extracted anions concentration. (auth)

25400 HIGHMOLECULAR, QUATERNARY AMMONIUMNITRATES AS REAGENTS FOR THE PARTITION CHROMATOGRAPHY OF INORGANIC IONS. Schmid, E. R.; Juenger, E.; Pollak, K. (Univ. Vienna). Mikrochim. Acta; 2: No. 4-5, 525-528 (1975). (In German).

The extraction capacity of highmolecular, quarternary ammonium nitrates (Hyamine-1622, Hyamine-10x, tetraheptylammonium nitrate) for metal ions is investigated by a paper chromatographic technique. (auth)

25401 ACID PRE-TREATMENT METHOD FOR IN SITU ORE LEACHING. Mallon, R. G.; Braun, R. L. (to U. S. Energy Research and Development Administration). US Patent 3,915,499. E21B43/28; E21C41/14. 28 Oct 1975. Filed date 23 Jul 1974. 6p. PAT-APPL-491,081.

An acid leaching method is described for the recovery of a desired element from a subterranean rubblized body of primary ore containing the element and also having associated therewith a carbonate mineral wherein the rubblized ore body is flooded with an aqueous acidic solution in order to release carbon dioxide from the associated carbonate mineral. After a substantial portion of the available carbon dioxide is released and removed from the ore body, as by venting to the atmosphere, an oxidizing gas is introduced into the flooded, rubblized ore to oxidize the ore and form an acid leach solution effective in the presence of the dissolved oxidizing gas to dissolve the ore and cause the desired element to go into solution. The leach solution is then circulated to the surface where the metal values are recovered therefrom.

25402 FAST RADIOCHEMICAL SEPARATION OF YTTRIUM FROM FISSION PRODUCTS. Rengan, K. (Eastern Michigan Univ., Ypsilanti); Griffin, H. C. Radiochem. Radioanal. Lett.; 24: No. 1, 1-8(15 Jan 1976).

A procedure has been developed for the isolation and purification of yttrium from fission products in less than two minutes. The procedure employs a solvent-pair system containing HCl and bis-(2-ethylhexyl)phosphoric acid. Efficient extraction and back extraction of yttrium is controlled by variations in the HCl concentration in the aqueous phase. The procedure has been applied to the study of short-lived yttrium isotopes. (auth)

25403 SELECTIVE SORPTION OF STRONTIUM FROM AQUEOUS SOLUTIONS BY NATURAL CLINOPTILOLITE. Nikashina, V. A.; Zaborskaya, E. Yu.; Makhalov, E. M.; Rubinshtein, R. N. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 739-741 (1974).

Translated from Radiokhimiya; 16: No. 6, 753-756(1974).

The natural selectivity of clinoptilolite was studied by determining the adsorption isotherm for Sr from a 0.003N solution of $CaCl_2$ over the range of Sr concentrations of 2.3×10^{-7} to 7×10^{-5} g-equiv/l on the Ca-form of clinoptilolite. The adsorption isotherm is linear over this concentration range. The kinetics of the Sr adsorption were examined over the same concentration range, and the data were found to conform to a mixed diffusion mechanism. (BLM)

25404 RAPID GAS THERMOCHROMATOGRAPHIC METHODS OF ISOLATING RADIOACTIVE ELEMENTS. VI. ISOLATION OF RADIOACTIVE ISOTOPES OF THALLIUM FROM IRRADIATED LEAD OXIDES. Bayar, B.; Zaitseva, N. G.; Novgorodov, A. F. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 877-881(1974).

Translated from Radiokhimiya, 16: No. 6, 901-906(1974).

A study was made of the gas thermochromatographic behavior of ultramicroamounts of thallium during their sublimation from irradiated lead oxides. On the basis of the results obtained hypotheses were put forward on the mechanism of the behavior of volatile thallium oxides and their chemical form in evaporation and transfer in the gas phase. The oxides PbO_2 and Pb_3O_4 may be used as targets for a fast, single isolation of radioactive isotopes of thallium, osmium, and mercury. (auth)

25405 RAPID GAS THERMOCHROMATOGRAPHIC METHODS OF ISOLATING RADIOACTIVE ELEMENTS. V. Formation of Volatile Oxides and Hydroxide of Rhenium in the System Rhenium–Tungsten and Their Gas Thermochromatographic Behavior. Bayar, B.; Votsilka, I.; Zaitseva, N. G.; Novgorodov, A. F. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 871-876(1974).

Translated from Radiokhimiya, 16: No. 6, 894-900(1974).

A study was made of the gas thermochromatographic behavior of microamounts of rhenium in a stream of helium and oxygen in relation to the water vapor content of the carrier gas and the sublimation temperature and time. The mechanism of the formation of volatile oxides and a hydroxide of rhenium in the combustion of tungsten is discussed. An estimate was made of the heats of adsorption of the volatile compounds of rhenium Re_2O_7, $ReO_3(OH)$, and ReO_3 on the surface of tungsten oxide and quartz. The experimental results show that gas thermochromatography makes it possible to separate radioactive isotopes of Re in a carrier-free state from irradiated tungsten metal simply and rapidly in a high chemical yield (87 ± 5%) with a purification factor greater than 10^3. (auth)

25406 THIN-LAYER CHROMATOGRAPHY IN INORGANIC ANALYSIS. IX. Adsorption Behavior of Americium in the Nitrate Solution–Silica Gel–Amine System. Milyukova, M. S.; Volynets, M. P.; Dubrova, T. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 11, 2145-2149(Nov 1975). (In Russian).

The behavior of americium (III) has been examined in the nitrate solution–silica gel–tri-n-octylamine (TOA) system by thin-layer chromatography. Maximum concentration of americium in the upper zones is achieved when using an initial solution 7.2 M in $LiNO_3$ and 0.1 M in HNO_3; saturation of the layer with 4 M solution of $LiNO_3$; using 0.1–0.2 M TOA solution in cyclohexane, equilibrated with 7.2 M $LiNO_3$ solution, as the mobile phase. Under such conditions, americium can be separated from nickel, lead, iron and partly from uranium and lanthanum and can be determined radiometrically in each zone on the plate with an error of 6 to 7%. (auth)

25407 SORPTION OF ACTINIUM AND EUROPIUM BY AN ANION EXCHANGER FROM A MIXTURE OF ORGANIC SOLVENTS IN THE PRESENCE OF MINERAL ACIDS. Karalova, Z. K.; Rodionova, L. M.; Pyzhova, Z. I.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 11, 2138-2144(Nov 1975). (In Russian).

The sorption of actinium and europium by anion exchanger AV-17 × B has been studied in the presence of organic solvents and their mixtures (acetone–ethanol) depending on the nature and concentration of mineral acids (HCl, HNO_3, H_2SO_4, H_3PO_4). It has been shown that actinium is adsorbed best from nitric acid solutions and europium from phosphoric acid solutions. A synergistic effect has been observed for actinium sorption in the acetone–ethanol–H_2SO_4 system. Conditions have been found for separating actinium from europium. (auth)

25408 COPRECIPITATION OF Be, Al, V, Cr, Fe, Ni, Cu, W, AND Re WITH MAGNESIUM HYDROXIDE. Novikov, A. I.; Ruzankin, V. I. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 746-749 (1974).

Translated from Radiokhimiya; 16: No. 6, 761-764(1974).

A study was made of the coprecipitation of carrier-free radioactive isotopes ^{7}Be, $^{48}V^{(V)}$, and ^{181}W, and small amounts of $^{51}Cr^{(III)}$, $^{186}Re^{(VII)}$, Al, Fe, Ni, and Cu with magnesium hydroxide in 1 M NH_4NO_3, 1 M NH_4NO_3 + 0.5 M NH_4HCO_3, and 1 M NH_4NO_3 + 0.5 M H_2O_2 in relation to the pH of the medium and other conditions. It was shown that Be, Al, Cr, Fe, Ni, and Cu may be concentrated by coprecipitation with magnesium hydroxide and Be, V, W, and Re may be separated from the carrier. A method is proposed for the separation of Al, Cr, Fe, and Ni from Be, V, W, and Re. The experimental data obtained agree with the coordination mechanism of sorption phenomena on hydroxides proposed previously. (auth)

25409 COPRECIPITATION OF YTTRIUM WITH ZIRCONIUM HYDROXIDE. Novikov, A. I.; Zakrevskaya, T. M. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 750-754(1974).

Translated from Radiokhimiya; 16: No. 6, 764-769(1974).

An investigation was made of the effect of the pH of the medium, the yttrium concentration, and the concentration of NH_4^+, Li^+, K^+, and Ca^{2+} on the sorption of Y by a $Zr(OH)_4$ precipitate with different orders of mixing of the reagents. The sorption of Y by $Zr(OH)_4$ is a surface process and cannot be explained satisfactorily by ion exchange or isomorphous coprecipitation. The sorption of Y by $Zr(OH)_4$ is accompanied by the liberation of protons into the solution; but the equivalence, which is characteristic of ion exchange processes, is not observed. The increase in the sorption of Y with an increase of the "neutral" base electrolyte occurs as a result of the simultaneous effects of the hydration of the ions of the base electrolyte and the dehydration of the carrier surface, which lead to an overall increase in the sorption of Y by the hydroxide precipitate. (auth)

25410 COPRECIPITATION OF ARSENIC(V) AND (III), SELENIUM(IV) AND (VI), AND TELLURIUM(IV) AND (VI) WITH ZIRCONIUM HYDROXIDE. Novikov, A. I.; Zakrevskaya, T. M. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 755-757(1974).

Translated from Radiokhimiya; 16: No. 6, 769-773(1974).

An experimental investigation was made of the coprecipitation of $^{74}As^{(V, III)}$ with zirconium hydroxide and the sorption of $^{125m}Te^{(IV, VI)}$ and $^{75}Se^{(IV, VI)}$ on zirconium hydroxide in relation to the pH of the medium, and conditions were determined for concentration of these elements. Conditions were found for determining the degree of oxidation of radioactive isotopes of As, Te, and Se from the amount of their coprecipitation with zirconium hydroxide over certain ranges of pH of the medium. The separation of selenium (VI) and selenium (IV) is carried out by coprecipitation of Se(IV) in 1 M NH_4NO_3 and 1 M $(NH_4)_2SO_4$ with zirconium hydroxide at pH = 5.5-8. The coprecipitation of arsenic (V) with zirconium hydroxide occurs in the region of existence of the anions $H_2AsO_4^-$ and $HAsO_4^{2-}$. The sorption of selenium and tellurium by zirconium hydroxide is most probably caused by the formation of surface compounds of the type $Zr-SeO_3^{2-}$, which are desorbed as the pH increases as a result of the decomposition of these compounds. (auth)

25411 COMPLEX FORMATION AND EXTRACTION PROPERTIES OF ORGANOPHOSPHORUS COMPOUNDS. II. Distribution of Extractant and Metals Between Aqueous and Organic Phases. Elesn, A. A.; Karaseva, V. A.; Ivanovich, N. A.; Zaitsev, A. A. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 758-761(1974).

Translated from Radiokhimiya; 16: No. 6, 773-777(1974).

An investigation was made of the distribution of 2-ethylhexylphenylphosphoric acid (2EHPPA) and metals (Am^{3+}, Cm^{3+}, and Pm^{3+}) between benzene and n-octane and aqueous solutions of ammonium perchlorate in realtion to the pH ($C_{2EHPPA} = 1 \times 10^{-3}$M), and it was shown that in the system with benzene 2EHPPA has higher distribution coefficients than with n-octane up to pH = 5. On the contrary, the distribution coefficients of the metals in the pH range of 1-3 are greater in the system with n-octane than with benzene. The experimental data are explained satisfactorily by the stoichiometric equation: $M_W^{3+} + 3A_W^- + 3HA_0 \rightleftharpoons MA_3(HA)_{30}$ with practically the same equilibrium constants for the different systems. The concentration of 2EHPPA in the aqueous phase of $(2-5) \times 10^{-4}$M is apparently the limit above which there begins the formation of colloidal aggregates, which are distributed randomly through the volume of the solution and sorbed on the walls of the vessel and at the interphase. (auth)

Inorganic, Organic, and Physical Chemistry

25412 (ORNL-5078, pp 28-51) CHEMISTRY. Ferris, L. M. Feb 1976.

In molten-salt reactor program. Semiannual progress report for period ending August 31, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Research progress is reported in programs on fuel-salt chemistry, properties of compounds in the Li-Te system, Te spectroscopy UF_4-H equilibria, porous electrode studies of molten salts, fuel salt-coolant salt reactions, thermodynamic properties of transition-metal fluorides, and properties of sodium fluoroborate. Developmental work on analytical methods is summarized including in-line analysis of molten MSBR fuel, analysis of coolant-salts for tritium, analysis of molten $LiF-BeF_2-ThF_4$ for Fe and analysis of $LiF-BeF-ThF_4$ for Te. (JRD)

25413 ASSOCIATION AND VAPOR PRESSURE ISOTOPE EFFECT OF VARIOUSLY DEUTERATED METHANOLS IN N-HEXANE. Wolff, H.; Bauer, O.; Goetz, R.; Landeck, H.; Schiller, O.; Schimpf, L. (Univ., Heidelberg). J. Phys. Chem.; 80: No. 2, 131-138 (15 Jan 1976).

Activity coefficients have been determined for solutions of CH_3OH, CH_3OD, CD_3OH, and CD_3OD in n-hexane between 35 and 75°C from isothermal vapor pressure measurements. Using Wilson's equations for representing the activity coefficients, curves for the partial pressure ratios of the deuterioisomeric methanols do not show oscillating behavior as they do when using the Redlich-Kister type representation. In each case, Wilson's parameters, association constants, association energies, heats of vaporization, and excess Gibbs free energies suggest that the energy of the deuterium bond of the methanols is larger than that of their hydrogen bond. An association energy of about 5 kcal/mole is derived using Wilson's representation, while the value of 6 to 7 kcal/mole derived from the Redlich-Kister representation is too large. The ratios $p(CD_3OH)/p(CH_3OH)$ and $p(CD_3OD)/p(CH_3OD)$ are inverse (greater than 1) in the whole concentration range, whereas $p(CH_3OD)/p(CH_3OH)$ and $p(CD_3OD)/p(CD_3OH)$ changes from normal (less than 1) to inverse as the mole fraction goes to zero. Previous measurements on methylamines showed a similar behavior, except that the inversion point (p/p' equals 1) occurs at a higher mole fraction. The pronounced difference is due to the weaker hydrogen bonding of the amino group compared to the hydroxyl group. (auth)

Chemical and Physicochemical Properties

Refer also to abstracts 25536-25538, 25540, 26486, 26682, 26833, 26839-26841, 26844, and 27636.

25414 (AD/A-006681) UNUSUAL METALLOPORPHYRINS. Technical Report. Tsutsui, M.; Hrung, C. (Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Chemistry). 1975. Contract N00014-68-A-0308-0006. 17p. NTIS $3.25.

The chemistry of unusual metalloporphyrins is reviewed. Various transition metal complexes, including carbonyl compounds are discussed. Structures are included. (GRA)

25415 (AD/A-007262) HIGH RESOLUTION SPECTRA OF RARE EARTH CRYSTALS. Final Report, 2 Oct 1969-30 Sep 1973. Crosswhite, H. M. (Johns Hopkins Univ., Baltimore, Md. (USA)). Mar 1975. Contract DAHC04-70-C-0007. 8p. NTIS $3.25.

Energy levels derived from the spectra of triply-ionized rare earths in hexagonal lanthanum trichloride single crystals have been reinterpreted using an expanded Hamiltonian including two- and three-body electrostatic and two-body magnetic effective operators in the free-ion part, and two-body crystal field operators added to the crystal interaction part. A method has been developed for dealing with the very large matrix dimensions encountered for ions in the middle of the series. (GRA)

25416 (ANL-75-46) CHEMICAL ENGINEERING DIVISION PHYSICAL INORGANIC CHEMISTRY ANNUAL REPORT, JULY 1974-JUNE 1975. Blander, M.; Cajigas, C. J.; Huang, H. S. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 47p. Dep. NTIS $5.50.

Thermal conductivity measurements of methanol vapor were made in a hot-wire cell at temperatures ranging from 306 to 345°K and pressures from 80 to 760 torr. Emf measurements of the activities of Li in Li-Mg alloys indicate small negative deviations from ideal behavior. Conformal ionic solution theory has been extended to fourth order for additive ternary molten salt systems (AX-BX-CX). A miscibility isotherm at 540°C for the Na,Ag parallel NO_3Br system measured by a visual titration method appears to be consistent with theoretical considerations. Certain phase relationships in the systems, Li-Fe-S, Li-Cu-Fe-S, and Li-Co-Fe-S at 400°C, which are of interest to the lithium/metal sulfide battery program, were investigated. Emf measure-

ments of Li-Al alloys relative to lithium were made. A value for the free energy of formation of Li_2C_2 was obtained from emf measurements. A study of the crystallization of metastable supercooled molten $MgO-SiO_2$ droplets was made as a function of composition and temperatures. An examination of the diffusion of oxygen isotopes in mineral grains indicates that the oxygen isotope anomalies found by Clayton et al., in inclusions in the Allende meteorite appear to have been formed by diffusion of ^{17}O and ^{18}O into materials very low in these isotopes. (auth)

25417 THERMAL STEREOMUTATION OF CYCLOPROPANES. Berson, J. A.; Pedersen, L. D.; Carpenter, B. K. (Yale Univ., New Haven). J. Am. Chem. Soc.; 98: No. 1, 122-143(7 Jan 1976).

The syntheses of optically active trans-1-phenylcyclopropane-2-d, (-)-13 and (+)-13, are achieved by Haller-Bauer cleavages of the corresponding ketones (+)-10 and (-)-10 with $NaND_2$. The optically active cis isomer (+)-14 is prepared from the cis ketone, (-)-17, by an analogous route. Three kinetic experiments on these compounds are carried out. (1) Pyrolysis of (-)-13 and (+)-13 to effect trans-cis isomerization at 309.5° in the gas phase. This reaction is first-order with a rate constant k/sub i/ equals 2.48 x 10^{-5} sec^{-1}. (2) The loss of optical activity from a synthetic equilibrium mixture, "V", composed of 50 percent each of (+)-13 and (+)-14, in which the enantiomeric purities of each are identical. This reaction also is first-order with a rate constant k/sub alpha//sup eq/ equals 4.06 x 10^{-5} sec^{-1}. (3) The decline of optical rotation of the kinetic samples from experiment 1. This reaction is not first-order, because the optical rotations of enantiomerically pure 13 and 14 differ slightly. The kinetics can be analyzed by numerical integration to determine k_1, the rate constant for unaccompanied single rotation of the phenyl-substituted carbon, C_1 (Scheme II) and k_{12} (and k_{13}), the rate constant for synchronous double rotation of C_1 and C_2 (or C_1 and C_3). The "best-fit" values are k_1 equals 0, and k_{12} equals 0.96 x 10^{-5} sec^{-1}. An assumed isotope effect of 10 percent gives k_{13} equals 1.06 x 10^{-5} sec^{-1}. Thus, each rotation of C_1 is accompanied by a synchronous rotation of C_2 or C_3. The result is that expected if the stereomutation pathway passes over a 0,0 trimethylene ("pi-cyclopropane"). Ozonolysis of (-)-13 to the acid (-)-18, conversion of the latter to trans-1-benzoylcyclopropane-2-d, and $NaND_2$ cleavage of the ketone gives trans-cyclopropane-1,2-d_2, $alpha_{365}$ +0.168° (neat, 1 dm). Pyrolysis of this hydrocarbon at 422.5° results in first-order approach to the trans-cis equilibrium mixture (rate constant k/sub 1/) and first-order decline of optical activity (rate constant k/sub alpha/). The ratio, k/sub i//k/sub alpha/ equals 1.07 +- 0.04, is most simply interpreted again as a synchronous rotation of two methylene groups (Scheme VII). 69 references (auth)

25418 TEMPERATURE DEPENDENCE OF VOLUME VISCOSITY OF ASSOCIATED LIQUIDS FROM HOLE THEORY. Pandey, J. D. (Univ. of Allahabad, India). Indian J. Pure Appl. Phys.; 13: No. 11, 731-733(Nov 1975).

Eyring's hole theory of volume viscosity (η_v) was used to investigate the temperature dependence of η_v for associated liquids. It was found that the ratio of the volume viscosity and shear viscosity is almost constant and independent of temperature. The resulting equation was tested for water, heavy water, n-propanol, and n-butanol, using the ultrasonic absorption data. (auth)

Isotope Effects

Refer also to abstracts 25507 and 27222.

25419 SORPTION OF WATER VAPOR IN PARTIALLY HYDROLYZED POLY(VINYL ACETATE). Spencer, H. G.; Honeycutt, S. C. (Clemson Univ., SC). J. Polym. Sci., Part C; No. 41, 129-137(1973).

The sorption kinetics of H_2O and D_2O in copolymers of partially hydrolyzed poly(vinyl acetate) were studied and compared with the sorption kinetics of vinyl acetate–vinyl alcohol copolymers, and poly(vinyl alcohol). The special measurement problems presented by transient-state sorption studies in water vapor–polymer systems and their effects on the results are discussed. (JSR)

25420 LONG RANGE DEUTERIUM ISOTOPE EFFECT ON A LANTHANIDE INDUCED CHEMICAL SHIFT. DePuy, C. H.; Fuenfschilling, P. C.; Olson, J. M. (Univ. of Colorado, Boulder). J. Am. Chem. Soc.; 98: No. 1, 276-278(7 Jan 1976).

A methanol solution of erythro and threo diasteriomeric methyl ethers, which differ only in position of hydrogen and deuterium atoms, were studied in the presence of the lanthanide shift reagent Eu(fod)$_3$ by NMR spectroscopy. The occurrence of two different methoxyl signals is suggested to be a result of different complexation with the shift reagent due to the difference in vibrational amplitude of the C–D bond and C–H bond. Evidence to support the proposed explanation is discussed, and it is suggested that chemical shift differences might prove useful in determining other conformations. (DDA)

25421 ISOTOPE EFFECTS ON GAS PHASE REACTION PROCESSES. I. The Determination of Equilibrium Isotope Effects by Ion Cyclotron Resonance Spectroscopy. Wolf, J. F.; Devlin, J. L. III; Taft, R. W.; Wolfsberg, M.; Hehre, W. J. (Univ. of California, Irvine). J. Am. Chem. Soc.; 98: No. 1, 287-289 (7 Jan 1976).

The possible accuracy of ion cyclotron resonance spectrographic equipment as a tool to study isotopic substitution effects on equilibrium processes involving ions in the gas phase was explored. The equilibria involving isotopic exchange of light and heavy isotopes of N_2 and O_2 molecules were studied. Because of error in measurement of the pressure ratios of the neutral molecules, the ion cyclotron resonance technique was determined to be inadequate for the study of these systems. However, since the isotopic effects of hydrogen-deuterium substitution are larger, the ion cyclotron resonance techniques might provide useful information in that system. (DDA)

25422 DEACTIVATION OF CO_2(010) AND CO_2(001) BY HYDROGEN AND DEUTERIUM. Stricker, J. (Department of Aeronautical Engineering, Technion-Israel Institute of Technology, Haifa, Israel). J. Chem. Phys. 64: No. 4, 1261-1265 (15 Feb 1976).

The probabilities of deactivating the bending and asymmetric stretching modes of CO_2 by hydrogen and deuterium are calculated semiclassically over the temperature range of 300–2000 °K. It is assumed that the molecular interaction potential consists of a superposition of atomic pair repulsion forces. For the CO_2(010) –H_2 case, an inverse temperature dependence of probability was found over the 300–500 °K range; no inverse temperature dependence was found for CO_2(010) –D_2. The calculations indicate that it is possible to attribute the vibrational relaxation to energy transfer between the vibrations of CO_2 and the rotation as well as translation of H_2/D_2. The different temperature dependences are essentially due to the difference between H_2 and D_2 in rotational energy matching with CO_2 vibrations. The calculated temperature dependence of the deactivation probabilities is in good agreement with experimental data. However, the measured absolute values are lower than the calculated ones. (auth)

25423 PHOTOIONIZATION MASS SPECTROMETRIC STUDY OF FORMALDEHYDE H_2CO, HDCO AND D_2CO. Guyon, P.M.; Chupka, W.A.; Berkowitz, J. (Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 64: No. 4, 1419-1436 (15 Feb 1976).

Photoionization efficiency curves for H_2CO^+, $HDCO^+$, D_2CO^+ and HCO^+, DCO^+ and CO^+ fragment ions are obtained. The ionization potentials of H_2CO, HDCO, and D_2CO thus determined are, respectively, 10.86_4, 10.87_9, and 10.88_2 eV. The appearance potential of HCO^+ fragment is observed at 11.92±0.01 eV, from which the dissociation energy of H_2CO^+, the proton affinity of CO, and the ionization potential of HCO are inferred. The heat of formation $\Delta Hf°_0$ (HCO^+) = 196.2±0.5 kcal/mole is obtained, a value lower than any one previous determination. From the abundance ratios measurements the variation of the mass spectrum with photon energy is determined, and hydrogen isotope effects are measured. The observation of a metastable transition $(D_2CO^+)_m \rightarrow DCO^+ + D$ with a threshold some 2 eV above the dissociation limit is discussed along with the dissociation mechanisms with the help of correlation diagrams. Finally, the finer structure in the photoionization efficiency curves is analyzed in terms of preionized Rydberg series converging to the second and third electronic state of the ion. (auth)

25424 THE SPECTRUM OF DO_2 NEAR 60 GHz AND THE STRUCTURE OF THE HYDROPEROXYL RADICAL. Beers, Y. (National Bureau of Standards, Boulder, Colorado 80302); Howard, C.J. J. Chem. Phys. 64: No. 4, 1541-1543 (15 Feb 1976).

Spectra for the lowest rotational transition in DO_2, $N=1\leftarrow0$, have been observed near 60 GHz. These data have been used to calculate the sum of the rotational constants $B+C$ for DO_2 = 60 467.7±3 MHz. This result was combined with other measurements on HO_2 to compute a structure for the hydroperoxyl radical: r (H–O) = 0.977×10^{-10} m, r (O–O) = 1.335×10^{-10} m, and ∠H–O–O = 104.1°. Also we have found for DO_2 that $(\epsilon_{bb}+\epsilon_{cc})/2 = -191\pm3$ MHz for elements of the electron-spin rotation tensor and a value of −4.2±1.5 MHz for the Fermi contact interaction parameter σ. (auth)

25425 DEACTIVATION OF HCl($v=1$) AND DCl($v=1$) BY H AND D ATOMS AT T = 295 K. Bott, J.F.; Heidner, R.F. III (The Aerospace Corporation, El Segundo, California 90245). J. Chem. Phys. 64: No. 4, 1544-1548 (15 Feb 1976).

The techniques of isothermal calorimetry (for H atoms) and laser-induced fluorescence [for HCl(1)] were combined to yield absolute rate coefficients for H and D atom removal of HCl(1) and DCl(1). At T=295 K, the rate coefficients for H+HCl(1), D+HCl(1), H+DCl(1), and D+DCl(1) are (4.6±1.4) ×10^{12}, (6.5±2.0) ×10^{12}, (1.1±0.3) ×10^{12}, and (1.2±0.4) ×10^{12} cm^3/mol·sec, respectively. (auth)

25426 LINEWIDTHS IN OCS: ISOTOPE EFFECTS, VIBRATIONAL EFFECTS, TEMPERATURE DEPENDENCE, AND T_1/T_2. Creswell, R.A.; Brown, S.R.; Schwendeman, R.H. (Department of Chemistry, Michigan State University, East Lansing, Michigan 48824). J. Chem. Phys. 64: No. 4, 1820-1827 (15 Feb 1976).

A computer-controlled microwave spectrometer has been used to record the frequency dependence of the absorption of the $J=2\leftarrow1$ transition of OCS under varying conditions of pressure, temperature, and microwave power. From least-squares fits of the data to Lorentzian line shapes, a variety of linewidths and linewidth parameters have been deduced. The linewidth parameter for the $J=2\leftarrow1$ transition of $^{16}O^{12}C^{32}S$ in the ground vibrational state has been determined to be 6.03 ± 0.05 MHz/torr. The ratios of linewidth parameters for this transition for several other species to that for the ground state of $^{16}O^{12}C^{32}S$ are: $^{16}O^{12}C^{34}S$, ground state, 0.987 ± 0.003; $^{16}O^{13}C^{32}S$, ground state, 0.991 ± 0.005; $^{18}O^{12}C^{32}S$, ground state, 0.966 ± 0.018; $^{16}O^{12}C^{32}S$, $v_3=1$, 1.024 ± 0.026; $^{16}O^{12}C^{32}S$, $v_2{}^{l}=2^{e}$, 0.978 ± 0.003. The linewidth parameter for the ground state of the parent species was determined to be inversely proportional to the absolute temperature in the range 297-346 K. From comparison of theoretical and experimental power-broadened lineshapes it is shown that $T_1/T_2=1.04\pm0.10$ for the transition. (auth)

25427 ISOTOPIC RELATIONS FOR POLYATOMIC MOLECULES. Makushkin, Yu.S.; Ulenikov, O.N. Opt. Spectrosc. (USSR) 39: No. 4, 353-356 (Oct 1975).

The quantum mechanical Hamiltonians of two different isotopic molecules that have the form $H=\Sigma_{Na}P^2_{Na}/2m_N+V$ and $H'\Sigma_{Na}P^2_{Na}/2(m_N+\mu_N)+V$ in space-fixed cartesian coordinates are transformed to molecule-fixed internal coordinates. In internal coordinates both Hamiltonians are expressed in terms of the equilibrium parameters, the normal frequencies, and the anharmonicity constants $k_{\lambda.....\mu}$ of one of the isotopes; one can thus obtain the isotopic relations for the parameters $x_{\lambda.....\mu}$ [the coefficients of $(V_\lambda+1/2)$,..., $(V_\mu+1/2)$ in the expressions for the vibrational energy], the rotational constants (taking into account their dependence on the vibrational quantum numbers), the τ coefficients, etc. (auth)

25428 ISOTOPE EFFECTS AT THE SURFACE OF INORGANIC SOLUTIONS. Heumann, K. G.; Hoffmann, R. (Regensburg Univ. (F. R. Germany). Inst. fuer Chemie); Luecke, W. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Petrographie und Geochemie). Z. Naturforsch., b; 30: No. 4, 497-502 (Jul 1975). (In German)

6 figs.; 2 tabs.; 20 refs.

Isotope effects were investigated at the surface of aqueous lithium and calcium salt solutions. The dependence on the temperature in the gas phase was determined. The surfaces of the solutions were isolated by spray experiments. In the case of calcium salt solutions an enrichment of the lighter isotope ^{40}Ca in relation to the heavier isotopes ^{44}Ca and ^{48}Ca was found at the solution surface. Experiments with lithium fluoride and lithium iodide gave inverse isotope effects. The calcium isotope effect could be qualitatively explained by the Gibbs theorem. The isotope separation of lithium possibly can be referred to the more covalent than ionic bonding character of lithium compounds at the solution surface. (DE)

25429 SYNTHESES, THERMOREORGANIZATIONS, AND SECONDARY DEUTERIUM ISOTOPE EFFECTS OF METHYLENE-VINYLCYCLOBUTANES. Mancini, G. J. Gainesville, FL; Univ. of Florida (1975). 138p. University Microfilms Order No. 75-23,002.

Thesis (Ph. D.).

The thermoreorganizations of methylene-3-vinylcyclobutane to 4-methylenecyclohexene and 1,1-divinyl-3-methylenecyclobutane to 4-methylene-2-vinylcyclohexene were investigated. Two mechanistic options were available for these rearrangements; one which involved the intervention of diradical intermediates, the other involved a concerted [3,3]-sigmatropic or Cope rearrangement. Activation parameters were determined for both of these pyrolyses. The heats of formation of their transition states were approximated by the group equivalent method, and these were consistent with the lower heats of formation, calculated for the speculated diradical intermediates. The indication from the kinetic data that diradical intermediates intervene in these thermoreorganizations was corroborated by an intermolecular secondary deuterium isotope effect study where the rates of reaction of 1,1-divinyl-3-methylenecyclobutane were compared with 1,1-di(vinyl-2,2-d_2)-3-methylenecyclobutane. The preponderant weight of analogy indicates that transformation of an isotopically substituted carbon from a trigonal to a tetrahedral orientation in the product should be associated with an inverse secondary deuterium isotope effect. However, a normal intermolecular isotope effect (k/sub H//k/sub D equals 1.05 +- 0.03) was observed at 99.9% which can be accounted for by a diradical process. From examination in the nmr of the product ratio, resulting from the thermolysis of 3-methylene-1-vinyl-1-(vinyl-2,2-d_2)-cyclobutane, an intramolecular isotope effect (k/sub H//k/sub D/ equals 1.14 +- 0.07) was determined. The discrimination process which gives rise to this kind of secondary deuterium isotope effect is thought to involve a twisting motion of an isotopically substituted, terminal methylene group, resulting in a nonplanar pentadienyl radical with concomitant destruction of pi-bonding at its terminus. (Diss. Abstr. Int., B)

25430 EQUILIBRIUM ISOTOPE EFFECTS AND REARRANGEMENTS OF CARBONIUM IONS. Telkowski, L. A. New Haven; Yale Univ. (1975). 134p. University Microfilms Order No. 75-24,606.

Thesis (Ph. D.).

Proton and carbon-13 NMR spectroscopy were used to obtain information about isotopic equilibria and rearrangements in carbonium ions. Investigation of methyl- and methylene-beta-D-labeled 1,2-dimethylcyclopentyl ions revealed that, in both cases, an equilibrium shift occurs to favor species in which the +-charge is located furthest from the site of isotopic substitution. For the methyl-labeled case, DELTA H equals 60 +- 1 cal/mol per D, while DELTA H equals 127 +- 2 cal/mol per D was calculated for the methylene-labeled case. A secondary carbon isotope effect was also found upon C-13 enrichment of one of the methyl groups. The equilibrium was shifted toward species in which the labeled methyl was adjacent to the +- charge. The data clearly indicate that methyl and methylene C–H vibrational frequencies are decreased upon introduction of a positive charge in a molecule, whereas there is a net increase in frequencies associated with the methyl carbon. In contrast, spectra of methylene-D-labeled methylcyclobutyl ion showed that an isotope effect on the process which equilibrates the methylene groups occurs so that deuterium preferentially occupies sites closest to the +-charge. Lineshape analysis of proton spectra of 1,2,3,5,7-pentamethyladamantyl ion yielded an E/sub a/ of 12.1 kcal/mol for the methyl scrambling process which proceeds via isomerization to tertiary protoadamantyl ions. The +-charge in dimethyladamantyl carbonium ion was shown to be preferentially located on the cyclic carbon although acyclic carbonium ions are generally known to be more stable than cyclic ones.

25431 MECHANISTIC IMPLICATIONS OF SUBSTITUENT EFFECTS ON SULFUR KINETIC ISOTOPE EFFECTS IN THE AQUEOUS SOLVOLYSIS OF SUBSTITUTED BENZYLDIMETHYL-SULFONIUM TOSYLATES. Friedberger, M. P. Philadelphia; Univ. of Pennsylvania (1975). 216p. University Microfilms Order No. 75-24,069.

Thesis (Ph. D.).

Much mechanistic work has been done on the solvolysis of substrates which react via so-called "borderline" mechanisms. Such substrates include secondary-alkyl and benzyl systems. Evidence indicates that return from an intermediate back to starting material can be very important in the overall mechanism. Study of a system in which return should be absent or at least minimized was desired. Substituted benzyldimethyl-sulfonium ions should be a good choice for such a system, since in this substrate the leaving group is a stable neutral species, dimethyl sulfide. The rate constants and sulfur kinetic isotope effects (k^{32}/k^{34}) for the solvolysis of several substituted benzyldimethylsulfonium tosylates in water at 68.73 +- 0.02° were determined. This reaction produces exclusively the corresponding benzyl alcohol, dimethyl sulfide, and acid. The kinetics, as measured by titration of the acid produced, is first order in sulfonium ion. Products were identified and measured by infrared spectrometry and high-pressure liquid chromatography. Isotope effects were measured by a dual inlet, dual detector, isotope-ratio measuring mass spectrometer. Hammett plots for both the aqueous solvolysis and the hydroxide displacement reactions of these compounds are curved upwards, with a minimum for the latter but no minimum for the former. Plots of isotope effect vs. substituent constant are linear, however, for both reactions, and this plot for the solvolysis of the para-substituted derivatives gives a linear plot with an especially good fit (correlation coefficient equals 0.992). The results can be explained equally well by a mechanism analogous to a Sneen ion-pair mechanism, in which an ion–dipole intermediate is formed, or by classical SN2–SN1-like mechanisms, in which the step involving ionization is rate determining for the p-methoxy derivative, and the step involving nucleophilic attack by solvent or nucleophile is rate determining for the other derivatives. The results cannot distinguish between the ion-dipole and the classical mechanisms, however. (JGB)

25432 CARBON-THIRTEEN KINETIC ISOTOPE EFFECT MODELING STUDIES ON THE DECOMPOSITIONS OF FORMIC ACID, DIMETHYL ETHER, AND OXALIC ACID. Kidd, R. W. Urbana, IL; Univ. of Illinois (1975). 167p. University Microfilms Order No. 75-24,342.

Thesis (Ph. D.).

The formic acid molecule was used as a model for the survey of the influence on calculated heavy-atom kinetic isotope effects (KIE's) of barrier curvature. Restrictions employed were: invariant geometry and basis diagonal force field; light species reaction coordinates eigenvector (L_1) consisting of one or two nonzero elements only. The formic acid molecule was used as a model for a computational comparison of the Willi–Wolfsberg curvature parameter (K) method (Type K) and the Johnston–Bonner–Wilson method (Type II), both including bond order (N) and barrier curvature effects, for calculation of ^{13}C KIE's involving L_1 consisting nominally of two nonzero elements. Results obtained by the two methods covered similar ranges of value of calculated k/k'. Intermolecular and intramolecular ^{13}C KIE's in the pyrolysis of dimethyl ether were analyzed. The isotope effects arise in the destruction of the symmetry of the reactant in hydrogen transfer reactions of the form $R + C^2H_3OC^1H_3$ yields $RH + .C^2H_2–OC^1H_3$, where R equals CH_3, H, or NO. The best match of model predictions and experimental data was obtained when: (a) transition state force constants were very product-like; (b) the relative internal coordinate displacements comprising L_1 are: C–C bond extension, C–O bond contraction, and O–H bond extension. (JGB)

25433 VAPOR PRESSURE ISOTOPE EFFECTS IN THE SYSTEMS. I. Acetone–Hexadeuteroacetone. IIA. Pyridine—Pentadeuteropyridine. IIb. Water + Pyridine–Water + Pentadeuteropyridine. III. Water + Dimethyl Sulfoxide–Heavy Water + Dimethyl Sulfoxide. Chan, T. C. Knoxville, TN; Univ. of Tennessee (1975). 146p. University Microfilms Order No. 75-26,705. Thesis (Ph. D.).

The absolute vapor pressures and the isotopic vapor-pressure differences in the systems acetone-h_6–acetone-d_6 (-65 to 60°), pyridine-h_5—pyridine-d_5 (25 to 60°), H_2O + pyridine-h_5–H_2O + pyridine-d_5 (25 to 65°), and H_2O + dimethyl sulfoxide–D_2O + dimethyl sulfoxide (30 to 70°), were measured using a high-precision differential method. The pressure data are presented and compared with those available in the literature. The vapor pressure isotope effects determined from these data are interpreted within the framework of the theory of condensed phase isotope effects. For binary systems, the partial pressures, and thus, the activity coefficients, and other excess thermodynamic functions such as the Gibbs free energy, the enthalpy, and the entropy are calculated from the total pressures. The results are discussed. (Diss. Abstr. Int., B)

25434 KINETIC SOLVENT DEUTERIUM ISOTOPE EFFECTS ON THE MICELLAR-CATALYZED HYDROLYSIS OF TRISUBSTITUTED PHOSPHATE ESTERS. Bunton, C. A.; Diaz, S. (Univ. of California, Santa Barbara). J. Org. Chem.; 41: No. 1, 33-36(9 Jan 1976).

Functional micelles of hexadecyl(2-hydroxyethyl)dimethylammonium bromide (I) are better catalysts than hexadecyltrimethylammonium bromide (CTABr) for the alkaline hydrolysis of diethyl and di-n-hexyl p-nitrophenyl phosphate (III). The kinetic solvent deuterium isotope effects for reactions catalyzed by CTABr are very similar to those for reaction in water, but for reaction of III in the presence of I the inverse isotope effect gradually disappears with increasing concentration of hydroxide ion. These results show that the inverse isotope effect is due to the ionization of I to its zwitterion II at high pH. They are consistent with nucleophilic attack by the alkoxide moiety in II but not with general acid or base catalysis. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 26101.

25435 (MIT-2793-1) NONEQUILIBRIUM PHOTOCHEMICAL REACTIONS INDUCED BY LASERS. Quarterly Progress Report, July 1, 1975–September 30, 1975. Steinfeld, J. I. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). Oct 1975. Contract E(11-1)-2793. 6p. Dep. NTIS $3.50.

Progress is reported in the following areas of research: ir double resonance of SF_6; ir-laser-induced chemistry; and, laser-driven thermal isotope diffusion, inducing ^{10}B enrichment. (JGB)

25436 SEPARATION OF B^{10} AND B^{11} ISOTOPES IN A STRONG INFRARED CO_2 LASER RADIATION FIELD. Ambartsumyan, R.V.; Gorokhov, Yu.A.; Letokhov, V.S.; Makarov, G.N.; Ryabov, E.A.; Chekalin, N.V. (Institute of Spectroscopy, Academy of Sciences of the USSR, Akademgorodok, Moscow Province). Sov. J. Quantum Electron. 5: No. 10, 1196-1197 (Oct 1975).

The results are given of experiments in which the B^{10} and B^{11} isotopes were separated in a strong ($\sim 10^9$ W/cm²) CO_2 laser radiation field which excited BCl_3 molecules with natural relative abundances of the boron isotopes. The $B^{10}Cl_3$ or $B^{11}Cl_3$ molecules were dissociated in the CO_2 laser radiation field and this was followed by the reactions of the dissociation products with various acceptors. The acceptors were O_2, HBr, C_2D_2, NO, and H_2. The dependences of the enrichment coefficient on the BCl_3 and acceptor pressures were determined. The separation efficiency was found and it amounted up to 25% of the molecules of the excited isotopic composition in the reaction zone for each radiation pulse. (auth)

25437 STEREOSPECIFIC INCORPORATION OF OXYGEN-18 INTO MANGANESE AND RHENIUM PENTACARBONYL DERIVATIVES VIA EXCHANGE REACTIONS WITH $H_2{}^{18}O$. Darensbourg, D. J.; Drew, D. (Tulane Univ., New Orleans). J. Am. Chem. Soc.; 98: No. 1, 275-276(7 Jan 1976).

The pentacarbonyl derivatives, $M(CO)_5L^+$, (where M equals Mn, Re and L equals PMe_2Ph, CH_3CN, C_5H_5N) underwent oxygen 18 enrichment by reaction with $H_2{}^{18}O$ in acetonitrile solvent, Ir spectrographic monitoring indicated preferential oxygen exchange at the equatorial CO ligand rather than at the axial ligand. Infrared spectra of gamma(CO) region at time intervals to T equals 53 hours were presented, and the observation was made that oxygen exchange was faster for the Mn derivative than for the Re derivative. (DDA)

25438 ISOTOPE SEPARATION BY RADIATION PRESSURE OF COHERENT π PULSES. Friedmann, H.; Wilson, A.D. (Department of Chemistry, Bar-Ilan University, Ramat-Gan, Israel). Appl. Phys. Lett. 28: No. 5, 270-272 (1 Mar 1976).

Limitations of existing methods of isotope separation, using atomic beam deflection induced by radiation pressure, are discussed. A new method, based on selective momentum transfer by intense unchirped reflected laser pulses, is proposed. The pulses produce population inversion in one isotope leaving the other unaffected. This population inversion is obtained using isotope selective optical precession. The method is supported by the full solution of the equations of motion of a two-level atom interacting with realistic light pulses of arbitrary strength. (auth)

25439 LITHIUM ISOTOPE SEPARATION FACTORS OF SOME TWO-PHASE EQUILIBRIUM SYSTEMS. Palko, A.A.; Drury, J.S.; Begun, G.M. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). J. Chem. Phys. 64: No. 4, 1828-1837 (15 Feb 1976).

Isotope separation factors of seventeen two-phase equilibrium systems for lithium isotope enrichment have been determined. In all cases, lithium amalgam was used as one of the lithium-containing phases and was equilibrated with an aqueous or organic phase containing a lithium compound. In all systems examined, isotopic exchange was found to be extremely rapid, and ^6Li was concentrated in the amalgam phase. The isotopic separation factor for the LiOH(aqueous) vs Li(amalgam) system has been studied as a function of temperature from −2 to 80 °C. The values obtained have been compared with the "electrolysis" and exchange separation factors given in the literature. The two-phase systems, LiCl(ethylenediamine) vs Li(amalgam) and LiCl(propylenediamine) vs Li(amalgam), have been studied, and the isotopic separation factors have been determined as functions of the temperature. The factors for the two systems have been found to be substantially the same (within limits of the errors involved) over the temperature range studied (0 to 100 °C) as those for the aqueous system. The isotopic separation factors for the seventeen systems have been tabulated, and correlations have been drawn that show the salt and solvent effects upon the values obtained. (auth)

25440 SELECTIVITY OF TWO-STAGE PHOTOIONIZATION OF ATOMS. Karlov, N.V.; Konev, Yu.B.; Prokhorov, A.M. (P.N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 11, 1336-1338 (Nov 1975).

A fairly general kinetic scheme is used in an analysis of two-stage pulse laser photoionization of a mixture of two isotopes. Expressions for the total number of selected ions, quantum efficiency, and separation coefficient are derived allowing for the resonant transfer of the excitation, charge exchange, and deterioration of the excitation selectivity due to absorption in the laser line wings. Various schemes for the separation of the required atoms are considered from the point of view of yield and efficiency of the method. (auth)

25441 ISOTOPIC ANALYSIS BY A RAMAN-SPECTROMETRIC METHOD. Kato, D. (Electrotechnical Laboratory, Tanashi, Tokyo, Japan). J. Appl. Phys. 47: No. 3, 1072-1075 (Mar 1976).

A versatile Raman-spectrometric method for a prompt and reliable isotopic analysis is described. It makes real-time analysis possible if needed. The Raman spectrometric method is applied to the analysis of deuterium in a mixture of D_2O and H_2O liquid. The Raman-spectrometric determination is found to agree closely with the volumetric one. Sensitivity of Raman spectrometry is confirmed well under 1 mol%. (auth)

25442 TEMPERATURE VARIATION OF THE SEPARATION FACTOR IN THE PROTIUM–TRITIUM AND DEUTERIUM–

TRITIUM SYSTEMS ON DISSOLUTION OF HYDROGEN IN PALLADIUM. Andreev, B. M.; Domanov, M. M. (Moscow Inst. of Chemical Engineering). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 5, 734-735(May 1975).

Translated from Zh. Fiz. Khim.; 49: No. 5, 1258-1259(May 1975).

The isotopic equilibrium in the hydrogen-palladium system has been investigated by a radiometric determination of tritium in the temperature range 0–60°C. The experimental separation factors for the protium-tritium and deuterium-tritium isotopic mixtures have been compared with values obtained by a quantum-statistical calculation. The temperature variation of the separation factor is described by the equation $\lg \alpha = -0.04 + 138/T$ in the protium-tritium system and by $\lg \alpha = 0.097 + 30.3/T$ in the deuterium-tritium system. (auth)

25443 METHOD FOR SEPARATING ISOTOPES. Jepson, B. E. (to U. S. Energy Research and Development Administration). US Patent 3,914,373. C01G57/00. 21 Oct 1975. Filed date 20 Jan 1973. 10p.

PAT-APPL-322,564.

Isotopes are separated by contacting a feed solution containing the isotopes with a cyclic polyether wherein a complex of one isotope is formed with the cyclic polyether, the cyclic polyether complex is extracted from the feed solution, and the isotope is thereafter separated from the cyclic polyether.

25444 CATALYZED EXCHANGES OF β-KETO ACID ESTERS IN DEUTERATED WATER. Fuksova, K.; Benes, J.; Hanus, J. (Inst. for Biological Research, Prague). Radiochem. Radioanal. Lett.; 24: No. 1, 19-29(15 Jan 1976).

The degree of deuteration in positions α and γ of β-keto acid esters was investigated in base- and acid-catalyzed exchange reactions with deuterated water. On the basis of the results obtained, methyl acetylacetate labelled with deuterium mainly in position γ was prepared and the probable mechanism for the trimethylamine-catalyzed exchanges was suggested. The deuteration position was determined with the aid of mass spectrometry, proton magnetic resonance and IR spectra, quantitative evaluation was done by mass spectrometry. (auth)

25445 STUDY OF HYDROGEN MOBILITY BY HYDROGEN-DEUTERIUM EXCHANGE. II. Theoretical Kinetic Study in Alkyl and Amino-Alkyl Pryimidines. Pompon, A. (Centre National de la Recherche Scientifique, 94- Thiais (France). Service de Spectrochimie Infrarouge et Raman). J. Chim. Phys.; 72: No. 4, 505-508(Apr 1975). (In French).

Alkyl groups bound to the pyrimidine ring can be deuterium-substituted on the carbon adjacent to the ring, in acidic D_2O; kinetic equations corresponding to various exchange mechanism hypotheses are established. It is shown that theoretical and experimental results can be compared in order to define the mechanism and to measure the characteristic parameters of the exchange reaction. (FR)

25446 PHOTOINDUCED H_2-D_2 EXCHANGE ON OXIDES CONTAINING IONS OF THE TRANSITION METALS. Shuklov, A. D.; Surin, S. A.; Shelimov, B. N.; Kazanskii, V. B. (Inst. of Organic Chemistry, Moscow). Kinet. Catal. (USSR) (Engl. Transl.); 16: No. 2, 395-397(1975).

Translated from Kinet. Katal.; 16: No. 2, 468-471(1975).

After irradiation with UV light in the presence of hydrogen at 77°K, aerosils with applied Co^{2+}, Ni^{2+}, and V^{5+} ions, as well as CoNaX, CoNaY, and NiNaY zeolites, become active catalysts of the reaction of H_2-D_2 exchange. The reaction rate at 77°K lies in the range $3 \cdot 10^{16}-2 \cdot 10^{17}$ 1/g·sec and is unchanged when the samples are exposed at this temperature. The long-wave limit of the photoactivation depends on the nature of the applied ion and lies in the region of 340–360 nm. The activation energy of the reaction of H_2-D_2 exchange is 0.2 kcal/mole. (auth)

25447 MARCUS EQUATION AND THERMODYNAMICS OF CATION–CATION OXIDATION-REDUCTION REACTIONS OF ACTINIDES. Rykov, A. G.; Blokhin, N. B. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 782-785(1974).

Translated from Radiokhimiya; 16: No. 6, 799-803(1974).

It was shown that in the general case the Marcus equation is valid for cation-cation oxidation-reduction reactions of actinides. By means of the Marcus equation, the standard free energies of activation of some isotope exchange reactions of actinides and d-elements which have not been studied were estimated. In 62% of the cases the standard free energies of activation for 43 cation-cation oxidation-reduction reactions of actinides studied, calculated by means of the Marcus equation, differ from the values determined experimentally by no more than 1.4 kcal/mole, and in 86% of the cases this difference is no more than 2.8 kcal/mole. (auth)

25448 INVESTIGATION OF THE PRINCIPLES OF HYDROGENATION AND ISOTOPIC EXCHANGE IN THE SERIES OF BENZENE AND ITS ALKYL DERIVATIVES ON A NICKEL CATALYST. Gudkov, B. S.; Mamaladze, L. M.; Kiperman, S. L. (Inst. of Organic Chemistry, Moscow). Bull. Acad. Sci. USSR, Div. Chem. Sci.; 24: No. 4, 681-687(Apr 1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 24: No. 4, 757-764(Apr 1975).

Data were obtained on the rates of hydrogenation and isotopic exchange with deuterium of benzene and its alkyl derivatives, permitting a comparison of the basic principles of these processes. In the transition from one hydrocarbon to another, the rate of hydrogenation varies in the sequence: benzene > ethylbenzene > toluene > m-xylene ≈ p-xylene ≈ o-xylene > mesitylene, but no regular variations of the rates of isotopic exchange, both in the aromatic ring and in the methyl groups, are observed. The comparison made indicates different mechanisms of the two processes. (auth)

25449 EXCHANGE OF DEUTERIUM WITH HYDROGEN ON THE SURFACE OF ZEOLITE CATALYST COMMUNICATION. III. Divalent Cationic Forms of Y Zeolites. Dmitriev, R. V.; Isakov, Ya. I.; Usachev, N. Ya.; Detyuk, A. N.; Minachev, Kh. M. (Inst. of Organic Chemistry, Moscow). Bull. Acad. Sci. USSR, Div. Chem. Sci.; 24: No. 5, 927-930(May 1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 24: No. 5, 1011-1015(May 1975).

The exchange rate of deuterium with hydrogen of the Mg, Sr, Cd, Zn, Ni, Co, and Mn forms of type Y zeolite was studied to determine the homogeneity of hydrogen in the zeolites. The catalysts were dehydrated in a stream of He, the system was evacuated, D_2 was admitted, and the composition of the gas above the zeolite was measured mass spectrometrically. The nature of the cation was determined to influence the concentration and mobility of the hydrogen. The hydrogen in CaNaY and SrNaY zeolites was observed to be kinetically homogeneous; however, at least two types of hydrogen were observed for the remaining zeolites as evidenced by difference in exchange rate with D_2. (DDA)

Feed Materials Processing

Refer also to abstract 25954.

25450 (ORNL-5078, pp 163-167) SALT PRODUCTION. Daley, F. L.; Horton, R. W. Feb 1976.

In molten-salt reactor program. Semiannual progress report for period ending August 31, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Experience with units operated for production of salt mixtures required for experiments in the MSR program is summarized. (JRD)

Radiation Chemistry

Refer also to abstracts 26063, 26131, 26132, 26825, 26857, 26860, 26861, and 26885–26887.

25451 (AD/A-008148) FREE RADICAL-INDUCED CHAIN BREAKAGE IN IRRADIATED AQUEOUS SOLUTIONS OF DNA. Meaburn, G. M.; Cole, C. M. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Mar 1974. 21p. (AFRRI-SR-74-3). NTIS $3.25.

The extent of chain breakage induced by free radical attack of calf thymus DNA in dilute aqueous solution has been determined by assay of liberated phosphomonoester groups. The relative effectiveness of hydroxyl radicals and hydrated electrons as initiators of this type of damage was investigated in both native and denatured DNA exposed to ^{60}Co gamma and 40-MeV electron radiation in the absence of oxygen. Approximately 8 percent of available OH and 6 percent of hydrated electrons react to produce chain breaks in double-stranded DNA, whereas these values are reduced to 5 percent and 1-2 percent respectively, for the denatured material. The double helical polynucleotide structure provides protection for reactive sites on the bases which are fully exposed to attacking radicals in single-stranded DNA. (GRA)

25452 (COO-3435-28) MICROWAVE-OPTICAL DOUBLE RESONANCE SPECTROSCOPY. Progress Report, February 1, 1975–January 31, 1976. Pratt, D. W. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 1 Nov 1975. Contract AT(11-1)-3435. 29p. Dep. NTIS $4.00.

Zero-field and high-field optical detection of magnetic reso-

nance (ODMR), electron paramagnetic resonance (EPR), and optical spectroscopy experiments were performed on several systems in order to further basic knowledge of the structure, reactions, and response to radiation of atoms, molecules, and ions. Results on the following studies are reported: the direct observation of level anticrossing and mixing effects in excited molecular triplet states; anomalous zero-field splittings in the lowest triplet state of 1-iodonaphthalene; evidence for second-order spin-orbit coupling and spin delocalization effects in the lowest triplet state of benzophenone; direct observation of the optical absorption spectra of reactive free radicals at room temperature; measurements of the activation and thermodynamic parameters of several cyclohexenyl and cyclohexanonyl radicals; complete analyses of the level anticrossing and cross relaxation spectra of oriented molecular triplet states; solutions to the spin Hamiltonian for S equals 1, I equals 5/2 systems in both zero-field and high-field, an improvement by a factor of ten in the resolution of ODMR experiments in high field; and measurements of the optical and magnetic resonance properties of a series of halogenated naphthalenes in their lowest triplet states. (auth)

25453 (CRN-CNPA-75-7) RADIOLUMINESCENCE OF FLUORESCENT COMPOUNDS IN SOLUTION IN SATURATED HYDROCARBONS. I. Luminescence Yields in Cyclohexane. Paligoric, D.; Klein, J. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 28p. (In French). INIS.

Results of a study of the evolution of radiation chemical luminescence yields G(RL) with concentration c of fluorescent solutes and charge scavengers in cyclohexane are presented. 1/G(RL) shows a linear dependence with $\sqrt{c}$; this fact is interpreted in terms of a radioluminescence mechanism based in neutralization processes occurring between anions and cations formed through charge scavengers by solutes; capture constants are determined for different solutes (PPD, PBD, $CHCl_3$ and C_2H_5Br). It is shown furthermore that a part of radioluminescence emission implies an energy transfer from excited cyclohexane molecules to the fluorescent solute characterized by a rate constant of the order of 10^{12} $mol^{-1}dm^3s^{-1}$. (FR)

25454 (CRN-CNPA-75-17) RADIATION DAMAGE IN SOLID BUTANE IRRADIATED BY Xe^+, Kr^+, Ar^+, Ne^+, He^+ IONS BELOW 1500 eV. Cailleret, J.; Paulus, J. M. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 20p. INIS.

Thick solid butane targets cooled at 77°K, containing known molar fractions of iodine, have been irradiated by monoenergetic rare gas ions with energies between 10 and 1500 eV. The nature and the importance of the fragmentation of the target molecules have been studied through the analysis of the formed organic iodides. The G values for the overall yield of organic iodides are roughly the same for the various ions investigated and they are energy-independent between 150 and 1500 eV. However the mode of fragmentation depends strongly on the nature of the particles, the probability of C-C bonds rupture increasing with the LET. The neutralization energy of the incoming ions is also assumed to play a part in the radiolysis of the target. (FR)

25455 (HMI-164) SCIENTIFIC PROGRESS REPORT 2/1974. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Sektor Strahlenchemie). 1974. 60p. (In German). INIS.

With figs., tabs., and refs.

The work in the field of radiochemistry has been carried out in the three following groups: pulse radiolysis (P), insulators and synthetics (IK), reaction kinematics (RK). Reactions of the hydrated electrons and the electronic behavior of short-lived free radicals have received thorough research in the group P for the last years, whereas energy states and reactions of excess electrons in dielectric liquids were investigated in the group IK. The recently taken up research on reactions of electrons and radicals on and in micelles and membranes, i.e. in heterogeneous systems with a lipoid and an aqueous phase, are based on knowledge of both groups The transition of an electron between the lipoid and aqueous phase can only be understood if the energy states of the electron are known in the individual phases. The reactive and elastic scattering of ions and molecules is investigated in the group RK as well as the formation of negative ions in the collision of alkali atoms with molecules. (DE)

25456 (JPRS-66663) INVESTIGATION OF RADIATION CROSS LINKING OF POLYETHYLENE IN HETEROGENEOUS SYSTEMS. Gordienko, V. P.; Kartel, N. T.; Suprunenko, K. A.; Doroshenko, V. N.; Kabakchi, A. M. Translated from Vysokomol. Soedin., Ser. A; 17: No. 8, 1737-1740(1975). 10p. NTIS.

Radiation cross-linking of low-density polyethylene containing disperse oxides of silicon and titanium in a wide range of concentrations at absorbed doses of 5-200 Mrad was analyzed. (auth)

25457 STRAHLENCHEMIE DES NATRIUMDIMETHYLPHOSPHATS IN WAESSRIGEN LOESUNGEN. EINE MODELLUNTERSUCHUNG ZUR STRAHLENSCHAEDIGUNG DER DNS. (RADIATION CHEMISTRY OF SODIUM DIMETHYLPHOSPHATE IN AQUEOUS SOLUTIONS. A MODEL STUDY ON THE RADIATION DAMAGE OF DNA). Omori, T. Muelheim, Ger.; Ruhr-Universitaet Bochum (1975). 140p.

Thesis.

^{60}Co gamma radiolysis and pulsed radiolysis of sodium dimethyl phosphate in aqueous solution were studied as simple model of DNA with the purpose of elucidating the mechanism of the phosphoric acid ester fission. In the pulse radiolysis of DMP in acid N_2O-saturated aqueous solution the rate constants of the reactions of the OH radicals and H atoms were determined. Dimers were formed in the γ radiolysis of DMP. In the γ radiolysis of DMP in basic Ar-saturated aqueous solution it was established that DMP reacts almost none with the hydrated electrons. During the radiolysis in the presence of N_2O/O_2 (80/20 vol %) the absorption spectrum of an intermediary product was observed. Under these conditions acids were formed. Electron capture reactions by the phosphate group did not contribute to the radio-induced breaks. In the radiolysis it was established kinetically that both the dimers and the monomers were formed from DMP radicals by a second-order time law. (JSR)

25458 HYDROGENATION OF BENZENE ON Pt/Pt BLACK. Sokol'skii, D. V.; Kuzembaev, K. K.; Burtsev, A. F.; Tugel'baeva, G. T. (Inst. of Organic Catalysis and Electrochemistry, Alma-Ata, USSR). Dokl. Chem. (Engl. Transl.); 222: No. 1-3, 303-304 (May 1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 1, 125-127 (May 1975).

The effect of irradiation of the catalyst with β- and γ-rays during gas-phase hydrogenation of benzene was studied. Results show that irradiation of Pt/Pt black with β-particles directly during the reaction led to an increase catalyst activity by a factor of almost two; however, gamma radiation does not have this promoting effect. (LK)

25459 RADIATION-INDUCED CHEMISORPTION OF OXYGEN ON SULFIDES WITH DIFFERENT WIDTHS OF THE FORBIDDEN GAP. Bigeliene, T.; Kalamazov, R. U.; Kokkozov, R.; Korshunova, G. D. (Inst. of Nuclear Physics, Tashkent). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 4, 559-561(Apr 1975).

Translated from Zh. Fiz. Khim.; 49: No. 4, 957-960(Apr 1975).

The kinetics of the radiation-induced and thermal chemisorption of oxygen on zinc, cadmium, and lead sulfides have been investigated by a manometric method and it has been shown that only thermal chemisorption is observed for PbS, while CdS shows both thermal and radiation-induced chemisorption and ZnS possesses in addition the capacity for the γ-adsorption effect. The concentrations of the active centers and the activation energies for the thermal and radiation-induced chemisorption have been calculated. The influence of the radiation-induced and thermal chemisorption of oxygen on the conductivity of the semiconductor has been observed. The observations can be explained from the standpoint of the electronic theory of semiconductors. (auth)

25460 EFFECT OF ION EXCHANGE ON KINETICS OF THERMOLYSIS (RADIOLYSIS) OF MIXED FORMS OF EXCHANGERS. Shiryaev, V. K.; Kasperovich, A. I. Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 4, 546-547(Apr 1975).

Translated from Zh. Fiz. Khim.; 49: No. 4, 934-936(Apr 1975).

The kinetics of the thermolysis (radiolysis) of a mixed form of an exchanger in an enclosed space in terms of the stability of the individual forms, the ion-exchange equilibrium constant, and the degree of dissociation of the decomposition products are derived. The ion in the more stable form has a "protective effect" on the less stable form. (auth)

25461 RADICAL FORMATION IN SALTS OF PYRIMIDINES. 1-Methyluracil.HBr Crystals. Flossmann, W.; Westhof, E.; Mueller, A. (Nuernberg Univ., Erlangen, Ger.). Int. J. Radiat. Biol.; 28: No. 2, 105-115(Aug 1975).

Radicals produced by x-irradiation at 77°K of 1-methyluracil, HBr crystals have been analyzed by electron spin resonance spectroscopy. The results are compared with those obtained on 1-methyluracil crystals. Four radicals have been identified, two of which are present only in 1-methyluracil.HBr crystals: the C6-addition radical and the pyrimidine-anion radical. Warming-up experiments have been performed in order to study the secondary radical reactions. The different mechanisms proposed for the radiolysis of DNA constituents in the solid state are discussed in connection with these findings. (auth)

25462 ESR STUDIES OF SULFUR-SUBSTITUTED PYRIMIDINES 2-THIO-5-CARBOXYURACIL AT 77°K. Bergene, R.; Sagstuen, E. (Univ., Oslo). Int. J. Radiat. Biol.; 28: No. 2, 137-146(Aug 1975).

Single crystals of 2-thio-5-carboxyuracil were irradiated and studied at 77°K with ESR spectroscopy. Five resonances were observed and related to the sulfur atom in the 2 position of the pyrimidine ring. Three of the resonances have been assigned to three conformations of a radical formed by hydrogen abstraction from N_1. The principal values for the nitrogen coupling are 9.7, 0.0 and 0.0 Gauss. The g tensor principal values are 2.173, 1.997, and 1.990 for the dominant conformation of this radical. Two other radicals could not be identified unambiguously. (auth)

25463 PHENOMENOLOGY OF EPR TRAPPED ELECTRON SPECTRA PRODUCED BY PHOTOIONIZATION IN ALKALINES AT 4.2°K AND 77°K. Lin, D. P. J. Chin. Chem. Soc. (Taiwan); 22: 1-6(1975).

Trapped electrons, e_t^-, are produced by photoionization of $K_4Fe(CN)_6$ in 10M NaOH/H_2O and 10M NaOD/D_2O glasses at 4.2°K. The linewidth, ΔH_{ms}, of e_t^- changes reversibly between these two temperatures in contrast to the observations for organic matrics. Three proposed mechanisms including dipole relaxation of pendent molecules surrounding the electron cavity, contraction-expansion model of cavity, and electron retrapping process are each discussed. It appears that no one physical model satisfactorily accounts for the present observations. The electron retrapping process, however, might be a better candidate for interpreting the experimental results in compatible with the optical absorption data. (auth)

25464 RADIATION EFFECTS IN POLYETHYLENE TEREPHTHALATES UNDER THE EFFECTS OF PROTONS AND CARBON IONS WITH ENERGIES OF 3 TO 150 keV. Kapchigashev, S. P.; Kovalev, V. P.; Sokolov, V. A.; Barkhatov, E. S. pp 57-59 of Voprosy mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

Studies were made of the radiation-chemical effects on organic materials (polyethylene terephthalates) under the effects of protons and carbon ions. The capacity of the polymer material to change its optical characteristics during irradiation was used as the test effect. The results showed that the efficiency of the change of optical density increased 2 to 3 times with decrease of the particle energy. Carbon ions are much more effective in changing the optical characteristics than protons of the same energy. In the case of irradiation of films by carbon ions the efficiency is almost constant in the energy range from 3 to 25 keV, whereas during irradiation with protons this effect was not observed. (JSR)

25465 REACTIONS AND QUENCHING OF VIBRATIONALLY EXCITED HYDROXYL RADICALS. Streit, G. E.; Johnston, H. S. (Univ. of California, Berkeley). J. Chem. Phys.; 64: No. 1, 95-103 (1 Jan 1976).

Rate constants for the deactivation of vibrationally excited hydroxyl radicals by the inert gases Ar, O_2, N_2, H_2, and D_2 were determined. Additionally the rate constants for the reaction $HO(nu) + O_3$ yields products have been measured and found to decrease from 11×10^{-12} to 3.7×10^{-12} cm^3 $molecule^{-1}$ s^{-1} from nu equals 9 to nu equals 4. Hydroxyl radicals were generated in a large tank at low pressures from the reaction of hydrogen atoms and ozone. The radicals were formed in excited vibrational states (nu less than or equal to 9), and the excited radicals, nu equals 4 to 9, were observed by visible light emission from high overtone transitions. Vibrational populations and the rate constants for loss processes were deduced from observations over a wide range of wavelength and pressure fitted to a comprehensive model of the system. (5 fig, 7 tables, 55 references) (auth)

25466 RATE CONSTANTS FOR THE REACTIONS OF OH WITH CH_4 AND FLUORINE, CHLORINE, AND BROMINE SUBSTITUTED METHANES AT 296°K. Howard, C. J. (Aeronomy Lab., Boulder, CO); Evenson, K. M. J. Chem. Phys.; 64: No. 1, 197-202(1 Jan 1976).

The absolute rate constants for the reactions of OH radicals with CH_4 and fifteen fluorine, chlorine, and bromine substituted methane molecules were measured using a discharge flow system and laser magnetic resonance detection of OH. Measurements were made at 296°K and at pressures between 107 and 1300 Pa. Results indicate that the reaction mechanism involves the abstraction of a hydrogen atom and formation of H_2O and a methyl type radical product. Completely halogenated methane molecules are found to be relatively unreactive. Hydrogen containing molecules react with rate constants ranging from about 0.2 to 160 x 10^{-13} cm^3/molecule . s. The reactivity increases with decreasing carbon-hydrogen bond energies. Rough estimates are made of the Arrhenius parameters for the reactions. (auth)

25467 TIME RESOLVED ELECTRON SPIN RESONANCE SPECTROSCOPY. III. Electron Spin Resonance Emission from the Hydrated Electron, Possible Evidence for Reaction to the Triplet State. Fessenden, R. W.; Verma, N. C. (Carnegie-Mellon Univ., Pittsburgh). J. Am. Chem. Soc.; 98: No. 1, 243-246(7 Jan 1976).

An improved version of fast response ESR spectrometer was used to study the spectrum of e⁻/sub aq/ in several chemical systems. The strong e⁻/sub aq/ signal at g equals 2.00033 was found in the methanol and sulfite systems. Ethylene, formate, and tert-butyl alcohol systems gave larger signals, and bromide and ferrocyanide systems gave smaller signals than the sulfite systems. In systems of carbonate, phosphite, hypophosphite, phenol, and hydroquinone the e⁻/sub aq/ ESR signal appeared in emission. The proposed explanation for the presence of the emission signal is that in the reaction between e⁻/sub aq/ and the counter radical in these systems, the product molecule preference is for the triplet state. A discussion of this theory is given. (DDA)

25468 TUNNELING ROTATION OF THE METHYL RADICAL IN THE $CH_3COONa.3D_2O$ CRYSTAL. Kubota, S.; Iwaizumi, M.; Isobe, T. (Tohoku Univ., Sendai). J. Am. Chem. Soc.; 98: No. 1, 293-294(7 Jan 1976).

A single crystal of $CH_3COONa.3D_2O$ was gamma irradiated, and the ESR spectra of the methyl radical was studied from 77°K to 4.2°K. At 77°K the radical is thought to be rotating freely about the threefold symmetry axis of the molecule; but as the temperature decreases, the rotational motion is expected to be strongly restricted. Six ESR spectra are presented which show additional splitting at lower temperatures. Analysis of the spectra confirm the expected quantum tunneling rotation of the radical in the crystal. (DDA)

25469 REDUCTION OF ADENINE DIHYDROCHLORIDE BY IONIZING RADIATION. Box, H.C.; Budzinski, E.E. (Department of Biophysics, Roswell Park Memorial Institute, Buffalo, New York 14263). J. Chem. Phys. 64: No. 4, 1593-1595 (15 Feb 1976).

The reduction product produced by ionizing radiation in single crystals of adenine dihydrochloride x irradiated at 4.2°K was studied by ESR-ENDOR spectroscopy. Addition of an electron to the protonated base yields a free radical with a spin density of approximately 0.30 on the C-8 carbon atom. The spin density was inferred from ENDOR measurements of the hyperfine coupling of the C_8-H proton. (auth)

25470 LIGHT-INDUCED DISPLACEMENT OF HYDROGEN IN PYRIMIDINE H—ADDITION RADICALS. Flossmann, W.; Westhof, E.; Müller, A. (Institut für Biophysik und physikalische Biochemie, Universität Regensburg, D-84 Regensburg, Germany). J. Chem. Phys. 64: No. 4, 1688-1691 (15 Feb 1976).

After x irradiation of single crystals of 1-CH_3-uracil, 1-CH_3-uracil-HBr, cytosine-H_2O, and deoxycytidine-HCl at room temperature C5-addition radicals, which result from H addition at carbon 5 of the unsaturated C5-C6 bond of the pyrimidine ring, are formed. It is shown that, upon irradiation with light of wavelength $\lambda > 400$ nm, these radicals transform into C6-addition radicals where the added hydrogen atom is localized on carbon 6. INDO calculations show that, whereas C5-addition radicals are neutral, the C6-addition radicals must be positively charged in order to reproduce the experimental couplings. (auth)

25471 METHOD FOR REMOVING AND DECOLORIZING AQUEOUS WASTE EFFLUENTS CONTAINING DISSOLVED OR DISPERSED ORGANIC MATTER. Case, F. N.; Ketchen, E. E. (to U. S. Energy Research and Development Administration). US Patent 3,912,625. B01D15/06. 14 Oct 1975. Filed date 5 Nov 1973. 6p.

PAT-APPL-412,850.

A method is provided for treating organic waste material dissolved or dispersed in an aqueous effluent, which comprises contacting the effluent with an inert particulate carbonaceous sorbent at an oxygen pressure up to 2000 psi, irradiating the resultant mixture with high energy radiation until a decolorized liquid is produced, and then separating the decolorized liquid.

25472 ENERGY TRANSFER IN THE GAMMA RADIOLYSIS OF AMMONIA-NOBLE GAS MIXTURES. Jezierska, K. (Higher Pedagogical School, Opole, Poland). Radiochem. Radioanal. Lett.; 24: No. 1, 9-17(15 Jan 1976).

The radiolysis of gaseous ammonia, sensitized by noble gases has been investigated. The radiation yield of hydrogen and nitrogen has been determined. It was found that the radiation efficiency $G^s(N_2)$ and $G^s(H_2)$ depends upon the kind of noble gas used in the NH_3/R system studied, but does not depend on the concentration of ammonia in the mixture. A possible mechanism of energy transfer has been proposed for the explanation of the results. (auth)

25473 EFFECT OF THE MEDIUM ON THE COMPOSITION AND YIELDS OF PEROXIDES FROM THE OXIDATION OF ISOSAFROLE AND STYRENE. Yakusheva, A. D.; Komarov, P. N. (Scientific-Research Physicochemical Inst., Moscow). Kinet. Catal. (USSR) (Engl. Transl.); 16: No. 1, 210-211(1975).

Translated from Kinet. Katal.; 16: No. 1, 248-250(1975).

An investigation has been carried out on the effect of the medium on the composition and kinetics of peroxide formation during the γ-ray initiated oxidation of isosafrole, styrene, and their 1.8 M solutions in acetic acid at 23°C. (auth)

25474 EFFECT OF IONIZING RADIATION FROM A NUCLEAR REACTOR ON THE ACTIVITY OF SUPPORTED PALLADIUM CATALYST. Sokol'skii, D. V.; Nadykto, B. T.; Gil'debrand, E. I.; Novikova, M. M.; Bogdanova, E. A. (Inst. of Organic Catalysis and Electrochemistry, Alma-Ata, USSR). Kinet. Catal. (USSR) (Engl. Transl.); 16: No. 1, 126-130(1975).

Translated from Kinet. Katal.; 16: No. 1, 156-161(1975).

The influence of neutron and gamma radiation from a nuclear reactor upon the activity of supported 0.5% Pd catalyst was studied. Spectroscopically pure $\gamma-Al_2O_3$ and $\gamma-Al_2O_3$ modified with hydrofluoric acid and with lithium hydroxide were used as carriers. It was found that irradiation of the carrier with neutron fluxes of 10^{16} n/cm^2 and more leads to enhanced catalytic activity of 0.5% Pd/Al_2O_3 in the liquid-phase hydrogenation of ethynyldimethylmethanol. Irradiation of $\gamma-Al_2O_3$ containing LiOH or HF lowers the activity of the corresponding catalyst. The possible mechanism of carrier modification by radiation is discussed. (auth)

25475 MULTIPLE TRANSITIONS INVESTIGATION IN UNPLASTICIZED AND PLASTICIZED POLYPROPYLENE BY THE RADIOTHERMOLUMINESCENCE METHOD. Solomko, V. P.; Vonsyatskii, V. A.; Boyarskii, G. Ya.; Nizhnik, V. V.; Krafchik, S. S.; Pelishenko, S. S. (Kiev State Univ.). Depov. Akad. Nauk Ukr. RSR, Ser. B; No. 11, 1017-1020(1975). (In Ukrainian).

Multiple transitions in pure and plasticized polypropylene were studied by the radiothermoluminescence method. Six maxima of luminescence were revealed on the polymer curve for the first time. These maxima are accounted for by definite kinds of molecular movement in polypropylene. Plastification is shown to affect the intensity and position of some of the indicated maxima. (auth)

25476 RADIOLYSIS OF CHLOROFLUOROETHANES AND CHLOROFLUOROPROPANES. Fukumizu, T.; Makide, Y.; Tominaga, T. (Tokyo Univ.). Radiochem. Radioanal. Lett.; 23: No. 5-6, 353-358(19 Dec 1975).

In the presence of bromine as scavenger, the γ radiolysis products of five kinds of chlorofluorocarbons were studied by gas chromatography. The G-values of the products derived from the C-Cl (or C-F) rupture mainly depend on the number of chlorine (or fluorine) atoms in the molecule. Moreover, the G-values for rupture of C-Cl or C-C bonds appear to be affected by the structural factors governing the bonding of chlorine atoms to carbon atoms. (auth)

25477 RADIATION CHEMICAL ISOMERIZATION OF LIQUID HYDROCARBONS. Wojnarovits, L.; Foldiak, G. (Inst. of Isotopes, Budapest). Radiochem. Radioanal. Lett.; 23: No. 5-6, 343-351(19 Dec 1975).

The radiolysis of isomers of butene, 1,2- and 1,4-dimethylcyclohexane as well as decalin was studied. It was found that the rate of isomerization toward the formation of the thermodynamically more stable species is higher than the reverse reaction, whether the mechanism of reaction is bimolecular (e.g. disproportionation of the corresponding monoradicals) or monomolecular (e.g. ring closure of biradical intermediates). (auth)

25478 RADIOLYSIS OF NITRITE ION IN THE PRESENCE OF BROMATE ION. Arnikar, H. J.; Patil, S. F.; Bodhe, A. A.; Pokharkar, R. D. (Univ. of Poona). Radiochem. Radioanal. Lett.; 23: No. 5-6, 307-315(19 Dec 1975).

The radiolysis of nitrite ion in the presence of bromate ion was studied. The disappearance of nitrite in pure nitrite solution is linear with the dose at the beginning and its concentration reaches a minimum, corresponding to a constant NO_3^-/NO_2^- ratio. In the presence of bromate, however, there is a complete conversion of nitrite to nitrate, the dose being adequate at all nitrite concentrations studied. The G values of nitrate in 0.25 mM nitrite solution with and without bromate (5 mM) are found to be 4.0 and 0.25 respectively. A mechanism consistent with the observed results is discussed. (auth)

25479 EPITHERMAL NEUTRON ACTIVATION ANALYSIS OF GALLIUM IN ALUMINA. Bereznai, T.; Keomly, G.; Miskei, M.; Vigvari, M. (Technical Univ., Budapest). Radiochem. Radioanal. Lett.; 23: No. 5-6, 369-377(19 Dec 1975).

A simple and rapid standard addition method is described for the determination of Ga in alumina of relatively high sodium content as compared to gallium. Ga is activated selectively under Cd-filter in the epithermal neutron energy range. Under the given experimental conditions, the detection limit is about 0.1 μg Ga at a sodium content of about 0.1%. The precision of the method is ±5% to 10% above a 50 ppM Ga level. (auth)

25480 RADIOLYSIS OF CYCLOHEXANE–HEXAMETHYLBENZENE MIXTURES. II. Experiments with Scavengers. Roder, M. Acta Chim. Acad. Sci. Hung.; 86: No. 3, 211-212(1975).

The ^{60}Co gamma radiolysis of cyclohexane-hexamethylbenzene mixture has been investigated in the presence of different scavengers I_2, N_2O, CCl_4 and c-C_3H_6. The radiation chemical yield of hydrogen, nitrogen and propane were determined as a function of composition. On the basis of the results it is concluded that the protective effect of hexamethylbenzene on the cyclohexane radiolytic decomposition can be accounted mainly for (about 90%) the transfer of positive charge from cyclohexane molecular cations to hexamethylbenzene. (auth)

25481 RADIOLYSIS OF THE COMPLEX OXALATES IN AQUEOUS SOLUTIONS. VI. Kinetics and Mechanism of the Radiolysis of Fe(III)-Trisoxalato-Complex in Aqueous Solution. Murgulescu, I. G.; Paun, J. (Univ. Bucharest). Rev. Roum. Chim.; 20: No. 9-10, 1195-1203(1975).

The α-Po and γ-^{60}Co radiolysis of potassium ferritrisoxalato-complex in acid and neutral, aerated and deaerated aqueous solution as well as in the presence of some scavengers has been studied. On irradiation the oxalato-complex readily decomposes, the resulting Fe^{2+} ions attaining a steady state concentration. This is determined by the two competing processes: reduction of Fe(III)-oxalato-complex ion by e_{aq}^-, H, HO_2 and oxidation of Fe(II)-oxalato-complex ion by OH, HO_2 and H_2O_2. The individual nature of ferric and ferrous oxalato-complex as well as the chemical form of the reducing and oxidizing species are strongly dependent on the pH value, presence or absence of air, and $C_2O_4^{2-}$ ion concentration. The evidence for the reaction: $C_2O_4^- + Fe(C_2O_4)_3^{3-} \rightarrow Fe(C_2O_4)_3^{4-} + C_2O_4^{2-} + 2CO_2$ is given. (auth)

25482 RADIATION CHEMISTRY OF SATURATED–UNSATURATED HYDROCARBON SYSTEMS. V. Liquid Phase γ-Radiolysis of C_3-Hydrocarbons. Foldiak, G.; Horvath, Z. (Inst. of Isotopes, Budapest). Acta Chim. Acad. Sci. Hung.; 86: No. 4, 385-396(1975).

Radiation chemical yields of hydrogen and several hydrocarbons were determined in the radiolysis of liquid binary mixtures of propane, propene and cyclopropane. The general opinion that interactions during the radiolysis of saturated-unsaturated systems decrease the G-values of products has been disproved. Therefore, neither the concept nor the expression of "protection" is accurate and general in the usual sense of the word; it is valid only for the limiting case of the formation of products in competing reactions from donor molecules. It has been established that, subsequent to energy transfer, acceptor molecules may also react chemically (e.g., in decomposition or addition reactions): this is also a route of energy dissipation. Relatively fast chemical processes requiring an activation energy were shown to promote energy transfer from the reaction partners similarly to molecules of lower ionization potential. Thus, each product requires a separate approach to establish the reaction mechanisms. The role of bimolecular processes is important if the competing unimolecular processes are not too fast. Such processes may lead to extrema on the yield curves and may facilitate the formation of products that are not formed from any of the pure components. It may be concluded that energy transfer occurs in both directions between the components of the mixture. In the limiting case, the rate of one of the transfer processes may be negligible in comparison with the reverse process. (auth)

25483 RADIATION CHEMISTRY OF SATURATED–UNSATURATED HYDROCARBON SYSTEMS. VI. Liquid Phase γ-Radiolysis of C_4-Hydrocarbons. Horvath, Z.; Foldiak, G. (Inst. of Isotopes, Budapest). Acta Chim. Acad. Sci. Hung.; 86: No. 4, 397-411(1975).

The radiation chemical yields of hydrogen and several hydrocarbons produced in the radiolysis of binary mixtures of n-butane, 1-butene, cyclobutane and cyclobutene have been determined. Conclusions drawn previously on the basis of the radiolysis of C_3 hydrocarbon systems have been confirmed. Several processes lead to the simultaneous formation of two or more radicals. If one of these interacts with the other component of the mixture, the lifetime of the rest of the radicals increases and so does the probability of their further reactions. It has been established that cyclobutane exhibits scavenger properties, similarly to cyclopropane, as assumed about the latter in the literature. It was observed for several binary mixtures that the plots of yields against the composition have absolute or "relative" maxima and minima, i.e., they have an inflection. This phenomenon

manifests itself, as a rule, in cases when the difference between the ionization potentials of the components is relatively small. This observation proves that energy transfer to the chemically less stable molecule, promoting its decompositions requiring some activation energy, and charge transfer to the component with the lower ionization potential may occur simultaneously; these two processes may take place in the same or in opposite directions. In the latter case, it is the composition that determines which of the processes will be predominant, thus the sign of the resulting deviation may also depend on the composition of the mixture. The linearity of the plots of yields vs. the composition does not mean in all cases that no interaction takes place between the components but may indicate that the effects of opposite processes have "accidentally" compensated each other. It can be concluded that the "G" value may be disputed when referred to individual components. The radiation energy utilized by individual components of the mixtures may not identical to that calculated on the basis of electron fraction, owing to various physical transfer processes. (auth)

25484 DOMAIN CONFIGURATIONS IN THE FERROELECTRIC PHASE OF KH_2AsO_4 FROM ENDOR STUDIES OF IRRADIATED CRYSTALS. Gaillard, J.; Gloux, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. de Resonance Magnetique). J. Phys. (Paris); 36: No. 7, 683-687(Jul 1975). (In French).

Using ENDOR spectroscopy, the radical AsO_4^{4-} created by gamma irradiation in KH_2AsO_4 crystals has been reexamined. An earlier study by Dalal et al. had shown the existence of two types of domains in the ferroelectric phase. By considering the origin of a small splitting of the ENDOR lines, it is shown that in fact this technique allows the detection of the four domain types which are expected to exist in KH_2AsO_4 as in KH_2AsO_4 (FR)

25485 PHOTOCONDUCTIVITY EVIDENCE FOR THE FORMATION OF N_2O^- BY THE RADIOLYSIS OF HYDROCARBON SOLUTIONS OF NITROUS OXIDE. Lukin, L. V.; Yakovlev, B. S. (Inst. of Chemical Physics, Moscow). Int. J. Radiat. Phys. Chem.; 7: No. 6, 667-677(1975). (In Russian).

Photoconductivity of iso-octane (2,2,4-trimethylpentane) solutions of nitrous oxide induced by a pulse of the light in the wavelength range from 360 to 900 nm was found after an x-ray pulse. The amplitude I_{ph} of the photocurrent pulse for 10^{14} molecules cm^{-3} N_2O solutions decreased with the characteristic time $\tau_{ph} \approx 7.10^{-4}$ s, as the time, t_d, between the x-ray pulse and the light pulse increased. The value for τ_{ph} weakly decreased as the nitrous oxide concentration increased from 10^{14} to 10^{15} cm^{-3}. The photoconductivity was assumed to be due to photodetachment of the electron from the ion N_2O^-. The decrease of I_{ph} with increasing t_d was thought to be associated with the instability of this ion. On the basis of the temperature dependence of τ_{ph} a dissociation energy 0.5 ± 0.1 eV for the N_2O^- ion in iso-octane was obtained. The decrease of τ_{ph} with increasing N_2O concentration was attributed to the reaction $N_2O^- + N_2O$ which reduced the N_2O^- concentration with a rate constant 1.10^{-12} cm^3 s^{-1}. The rate constant 1.5×10^{-8} cm^3 s^{-1} of electron scavenging by N_2O was obtained by investigation of the decay kinetics of electron-pulse-induced conductivity of nitrous oxide solutions in iso-octane at room temperature. (auth)

25486 INVESTIGATION OF THE POLYMERIZATION OF ETHYLENE BY $TiCl_3$. I. Determination of the Number of Centers of Growth and of the Velocity Constants of the Reactions of Growth and Chain Transfer. Zakharov, V. A.; Bukatov, G. D.; Kudchenko, V. K.; Ermakov, Yu. I. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Catal. (USSR) (Engl. Transl.); 16: No. 2, 351-357(1975).

Translated from Kinet. Katal.; 16: No. 2, 417-424(1975).

The method of radioactive inhibitors was used to determine the number of centers of growth (C_p) and the velocity constant of growth (K_p), in the polymerization of ethylene by $TiCl_3$. It was found that the value of C_p (less than $1.5 \cdot 10^{-4}$ mole/mole Ti) did not exceed 0.5% of the number of surface ions of titanium. The effects of the polymerization conditions on the molecular weight of the polymer were investigated. Chain transfer constants were determined from these data and from the value of K_p, found by an independent radiochemical method. (auth)

25487 INFRARED SPECTROSCOPIC STUDY OF THE RADIATION ADSORPTION OF CH_3OH AND H_2O ON SiO_2 BeO. Ermatov, S. E.; Kosherov, T. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 6-10(1974). (In Russian).

The effects of x radiation on the adsorption of water and methanol vapor on the surface of SiO_2 and BeO were studied by ir spectroscopy. The electron microscopic pictures of the oxide surfaces obtained under different conditions of thermal processing and x-radiation doses were examined. It was shown that after adsorption of methanol and water vapor on SiO_2 and BeO the x radiation causes the appearance of supplementary bands in the ir spectra. These indicate the existence on the surface of decomposition products of the adsorbed alcohol as a result of esterification reactions. (tr-auth)

25488 PROCESSES FOR THE ADSORPTION OF GASES AND VAPORS ON n, γ IRRADIATED SILICA GEL. Ermatov, S. E.; Kosherov, T. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 11-15(1974). (In Russian).

The processes of adsorption of O_2, H_2, H_2O vapor, and CH_3OH vapor on silica gel after n, γ irradiation were studied for a wide dose interval from 1 to 60 Mrad. The adsorption kinetics of O_2 and H_2 at different radiation doses and different temperatures for the processing of the adsorbent were examined. (tr-auth)

25489 EVIDENCE FOR SPURS IN AQUEOUS RADIATION CHEMISTRY. Fanning, J. E. Jr. Neward, DE; Univ. of Delaware (1975). 128p. University Microfilms Order No. 75-23,666.

Thesis (Ph. D.).

The rates of decay of the hydrated electron absorbance at 633 nm in pure water and in solutions of KBr, 2-propanol, $Ba(OH)_2$ and O_2 were studied as a function of time and of dose per 20 nsec pulse of 15 MeV electrons. A plot of the hydrated electron decay rate corrected for e⁻/sub aq/ concentration, (-d[e⁻/sub aq]// [e⁻/sub aq/])/dt vs (time)/sup ⅓/.(dose)/sup ⅓/ for solute free water yields a sharp transition from dose independent hydrated electron decay (intraspur decay) to dose dependent decay (interspur decay). This transition is interpreted as the onset of detectable spur overlap. In the range 0-8000 R per 20 nsec pulse, an empirical constant (time)/sup ½/.(dose)/sup ⅓/ equals $1.1_0 \times 10^2$ nsec/sup ½/ R/sup ⅓/ (standard deviation equals +-2) is obtained. A second less well defined transition is observed at the minimum in a plot of the instantaneous apparent second order rate constant (-d[e⁻/sub aq/]/[e⁻/sub aq/]²)/dt vs time and is attributed to the approach to or attainment of homogeneity within the aqueous system. For this second transition the empirical constant is (time)/sup ½/.(dose)/sup ⅓/ equals $2.1_5 \times 10^2$ nsec/sup ½/R/sup ⅓/ (standard deviation equals +-14). Based upon these transitions, the need to include spur overlap terms in modeling studies is discussed. The solution studies were performed by variation of both solute concentration and dose. These studies are discussed in relation to their support of the solute-free work and their demonstration of nonhomogeneity within the irradiated aqueous system. The potential value of all data presented to modeling efforts is emphasized. An appendix containing the raw experimental data for both the solute-free and solute-containing solutions is expected to assist modeling efforts. (auth)

25490 RADIATION CHEMISTRY AND PHOTOCHEMISTRY OF ETHYL BROMIDE IN THE GAS PHASE. Frank, A. J. Gainesville, FL; Univ. of Florida (1975). 216p. University Microfilms Order No. 75-23,889.

Thesis (Ph. D.).

The primary and secondary decomposition modes of gamma-irradiated ethyl bromide in the gas phase at room temperature have been investigated. Supplementary information on the system has been derived from a parallel study of the 253.7 nm photolysis and the high-pressure mass spectrometry. The G values and quantum yields of the major and minor products both in the absence and in the presence of oxygen are reported. In both the photolysis and radiolysis several products exhibit a well-defined induction period. For the oxygen-free system in the dose range from 1.0×10^{20} e.v./gram to 1.5×10^{20} e.v./gram the major radiolytic products and their respective G values are hydrogen bromide, 3.89; hydrogen, 1.39; ethane, 2.70; ethylene, 2.17; acetylene, 0.31; methane, 0.0831; methyl bromide, 0.080; vinyl bromide, 0.32; 1,1-dibromoethane, 0.88 and 1,2-dibromoethane, 0.12. In the photolysis of the pure system between 60 and 90 seconds at an absorbed light intensity of 7.7×10^{15} quanta/sec, the major photolytic products and their respective quantum yields are hydrogen bromide, 0.26; ethane, 0.40; ethylene, 0.028; methane, 0.00052; methyl bromide, 0.00091; vinyl bromide, 0.009; 1,1-dibromoethane, 0.102 and 1,2-dibromoethane, 0.0092. Carbon-halogen bond rupture is the major primary event in each system. There is also substantial evidence for HBr elimination. In addition, all secondary processes in the photolysis apparently occur in the radiolysis as well. A numerical integration method capable of handling steady-state assumptions has been used to calculate the product distribution based on the proposed photolysis mechanism. The predicted and experimental product distributions are found to be in reasonable agreement. (auth)

25491 SYNTHESIS OF ALKYLTRIHALOGERMANES. Chernoplekova, V. A.; Sheverdina, N. I.; Zemlyanskii, N. N.; Kocheshkov, K. A. (Physicochemical Inst., Moscow). J. Gen. Chem. USSR (Engl. Transl.); 45: No. 7, 1497-1498(Jul 1975).

Translated from Zh. Obshch. Khim.; 45: No. 7, 1528-1529(Jul 1975).

The reaction of germanium tetrachloride with tetraethyl- and tetra-butyl-stannanes at ordinary temperature under conditions of γ-irradiation by ^{60}Co with formation of mixtures of alkyltrichlorogermanes and trialkylchlorostannanes was investigated. It was found that not only germanium tetrachloride, but also the tetrabromide undergoes this reaction, and the method is applicable for the synthesis of alkyltrihalogermanes containing higher alkyl groups (hexyl, heptyl). (auth)

25492 EFFECT OF RADIATION FROM METAL IONS ON ADSORPTION PROPERTIES OF SEMICONDUCTOR MATERIALS. Sotnikov, V. S.; Beletskii, P. N.; Baru, V. G.; Batasheva, V. V.; Antraptseva, I. F. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 890-892(1974).

Translated from Radiokhimiya; 16: No. 6, 913-916(1974).

The adsorption of radioactive and nonradioactive isotopes of metal ions on unoxidized surfaces of Ge and Si from solutions in the presence of Hf was determined. The adsorption was studied under two sets of conditions: adsorption of radioactive impurities on the surfaces and adsorption of nonradioactive impurities on surfaces followed by activation of the metal impurities. The latter activation technique was not applied to Ge surfaces, since this would produce up to 14 Ge isotopes which interfere with the determination of the impurities. A theoretical presentation is included which predicts that if the radiation is not too high (R ≤ 100 Ci/g solution), the change in adsorption capacity of the high-resistance Ge will be changed very little (10^{-2}%) and that of high-resistance Si by < 10%. This theory is supported by the experimental data. (BLM)

25493 RADIOLYSIS OF CYTOSINE IN DILUTE NEUTRAL AQUEOUS SOLUTION. Gorin, G.; Ohno, N.; Raff, L. M. (Oklahoma State Univ., Stillwater). J. Phys. Chem.; 80: No. 2, 112-119 (15 Jan 1976).

Cytosine, 0.1 to 10 mM, has been radiolyzed at constant dose rates in 0.02 M phosphate buffer, pH 7. If the pH is then adjusted to 3, the absorption of the radiolysis products at 275 nm becomes negligible, and the radiochemical decomposition yield G(–cyt) can be calculated from the decrease in absorbance. In oxygen-saturated solutions it is described by the expression (D* equals dose in krad): G(–cyt) equals 3.3 – 0.024D* (to at least 40 percent decomposition). The radiolysis products react with the radicals derived from the solvent about one fifth as fast as cytosine does. The radiolysis products have appreciable absorbance at less than 260 nm and pH 3, and at 266 nm and pH 7 or 11. The spectral characteristics of the predominant products resemble those of known dihydrocytosine derivatives. In solutions containing greater than 1 mM cytosine and initially saturated with air, the oxygen is soon depleted; in absence of oxygen, different radiolysis products having a higher absorbance are formed. (auth)

25494 KINETICS OF RADICAL DECAY IN CRYSTALLINE AMINO ACIDS. II. High-Temperature Study. Joshi, A.; Johnson, R. H. (Florida State Univ., Tallahassee). J. Phys. Chem.; 80: No. 1, 46-51(1 Jan 1976).

Radical decay in x-irradiated L-leucine, and DL-valine, L- and DL-alanine, and L-arginine hydrochloride was studied between 300 and 430°K. Free radical decay was observed to take place with two distinct rates: an initial short duration process having an activation energy of 18 kcal/mole and a second, slower process. In most cases, the fraction of radicals decaying by the faster process is the same as the very slow room-temperature decay previously observed. The major process has a 3-6-kcal/mole higher activation energy. There is no evidence of radical conversion in either the initial or the slower process. However, in at least two cases residual peroxy radicals were observed at the termination of the slower process. Both decays obey second-order rate laws. The peroxy radical in at least one case decayed by a second-order law also. Vacancy controlled bulk diffusion is proposed for the major process, and the initial process is thought to be a conformationally aided bulk diffusion. It was observed that at any given temperature the spin concentration reaches a constant value. Increasing the temperature results in a second decay to a new constant value in a stepwise fashion. In the case of hydrated L-arginine hydrochloride and its partially deuterated derivative, the decay was found to be related to the dehydration process. A rapidly propagating radical transfer mechanism involving hydrogen abstraction is postulated for this decay process. (auth)

25495 PULSE RADIOLYTICAL INVESTIGATION OF THE REVERSIBLE REACTION OF BIPHENYL WITH THE SOLVATED ELECTRON IN LIQUID AMMONIA. Farhataziz; Perkey, L. M. (Univ. of Notre Dame, IN). J. Phys. Chem.; 80: No. 2, 122-126 (15 Jan 1976).

From the measured solubility of biphenyl in liquid ammonia for the temperature range 21 to - 15.5°, 9.4 kcal mole^{-1} for the heat of solution and 30 cal deg^{-1} mole^{-1} for the entropy of solution for a 1 M standard state are calculated. Nanosecond pulse radiolysis of biphenyl solutions in liquid ammonia show that the reaction of e/sub am/$^-$ with biphenyl produces the biphenyl anion and it is reversible. From the values of the equilibrium constant (the equilibrium concentration of the biphenyl anion divided by the initial concentration of biphenyl and the equilibrium concentration of e$^-$/sub am) at 21.6 and 10.5°, - 20 kcal mole^{-1} for the heat of reaction and - 44 cal deg^{-1} mole^{-1} for the entropy of reaction for a 1 M standard state are calculated. The specific rate of the reaction of e$^-$/sub am/ with biphenyl is equal to 1.24 x 10/sup (12-1600/2.3RT)/ for the temperature range 21.6 to - 75°. The extinction coefficient of the biphenyl anion at 0.403 mu, the wavelength of maximum absorption, is 3.1 x 10^4 M^{-1} cm^{-1} for the temperature range 23 to - 76.5°. The calculated values of the standard heat of formation of e$^-$/sub am/ and the entropy of e$^-$/sub am/ for a 1 M standard state are - 14 kcal mole^{-1} and 13 cal deg^{-1} mole^{-1}, respectively. (auth)

25496 KINETICS OF THE X-RAY IRRADIATION-CAUSED DEGRADATION OF PHOTOLUMINESCENCE OF SOME PHOSPHORS. Bauer, G. T. (Xerox Corp., Rochester, NY). J. Electrochem. Soc.; 123: No. 1, 79-85(Jan 1976).

The growth of absorption and the degradation of photoluminescence of calcium tungstate and zinc silicate phosphors were studied as functions of x-ray exposure. The characteristics of the growth curves were observed to be very similar to those reported for F centers in alkali halides. Based on the theoretical analysis of the kinetics, the fast initial growth of the absorption is interpreted as arising from the imperfections present in the phosphors prior to irradiation, while the following slow linear rise is attributed to the effect of new radiation-induced imperfections. From the two stages of growth curves, the two periods of degradation of photoluminescence observed could be quantitatively explained. These results indicate that the uv and visible absorption of radiation-produced color centers is the major cause of degradation of the phosphors studies. The observed dark recovery of absorption and of luminous efficiency after ceasing the irradiation of the phosphors was also found to be a correlated effect. (auth)

25497 EXPERIMENTS ON THE ORIGIN OF MOLECULAR CHIRALITY BY PARITY NON-CONSERVATION DURING BETA-DECAY. Bonner, W. A. (Stanford Univ., CA). J. Mol. Evol.; 4: 23-39(28 Nov 1974).

From international symposium on generation and amplification of asymmetry in chemical systems; Juelich, Germany (24 Sep 1973).

Experiments are described to test a theory for the origin of optical activity wherein the longitudinally polarized electrons resulting from parity violation during radioactive beta-decay, and their resulting circularly polarized bremsstrahlung, might interact asymmetrically with organic matter to yield optically active products. The historical background to this subject is briefly reviewed. Our experiments involve subjecting a number of racemic and optically active amino acid samples to a beta-radiation source for a period of 1.34 years (total dose: 411 Mrads), then examining them for any asymmetric effects by means of optical rotatory dispersion and analytical gas chromatography. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 26349 and 26524.

Hot-Atom Chemistry

25498 (CEA-N-1817(Suppl.), pp 51-54) ON-LINE MOESSBAUER EFFECT AND RECOIL EFFECTS. Jeandey, C.; Peretto, P. 1975. (In French)

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin no. 7, January–June 1975. ILL experiments. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

On-line Moessbauer experiments were performed using the reactions ^{56}Fe(n,γ)^{57}Fe and ^{177}Hf(n,γ)^{178}Hf respectively populating the resonance levels 14.4 keV $^3/_2^+$ in ^{57}Fe and 93 keV 2^+ in ^{178}Hf. Experiments were performed with iron and hafnium pure metals, Fe-Al and Ni-Fe substitution alloys and Fe-Ge covalence alloys and a complex molecule (iron acetylacetonate). The on-line experiments are as precise as conventional Moessbauer experiments but the recoil effects that follow the neutron capture cannot be cancelled. (FR)

25499 (CRN-CNPA-75-10) SZILARD-CHALMERS EFFECTS IN HAFNIUM COMPLEXES. II. Contribution of the Perturbed Angular Correlation Technique. Abbe, J. C.; Marques-Netto, A. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 13p. INIS.

Time differential measurements of the 133-482 keV γ-γ angular correlation of ^{181}Ta have been performed in solid EDTA and CDTA hafnium complexes either labelled or irradiated in a reactor. The informations deduced on the fate of the hot atoms are compared with data obtained through radiochemical analyses. (FR)

25500 TIME DIFFERENTIAL PERTURBED ANGULAR CORRELATIONS STUDY IN Hf(IV) MANDELATES COMPLEXES: STEREOSPECIFICITY AND SZILARD-CHALMERS EFFECTS. Boussaha, A.; Netto, A. M.; Abbe, J. C.; Haessler, A. (Univ. Louis Pasteur, Strasbourg). Radiochem. Radioanal. Lett.; 24: No. 1, 43-50(15 Jan 1976).

TDPAC measurements have been performed on ^{181}Ta nuclei in complexes of hafnium(IV) with dl, d, and l mandelic acid. The changes of the quadrupole interaction parameters with the nature of ligands is discussed in terms of a stereospecific effect. The consequences of the neutron capture reaction ^{180}Hf(n,γ)^{181}Hf in the dl complex are studied. (auth)

Properties of Radioactive Materials

Refer also to abstracts 25395, 26485, 26609, 26840, 26841, and 26844.

25501 (FRNC-TH-580) UPPER VALENCE STATES OF Pu. Musante, Y. (Lyon-1 Univ., 69 (France)). 1975. vp. (In French). INIS.

The properties of the Pu(VI) and Pu(VII) ions in aqueous solutions were investigated. Topics reported include: spectrophotometric studies of the formation of PuO_2^{2+} complexes with hydroxyl ions; electrochemical studies of PuO_2^{2+}; preparation, determination, and coprecipitation of Pu(VII); electrochemical study of Pu(VII). A preliminary study was made on the chemistry of Pu in non-aqueous solutions especially the dissolution and the determination of Pu in propylene carbonate. (FR)

25502 KINETICS AND MECHANISM OF THE OXIDATION OF URANIUM (IV) BY HYPOCHLOROUS ACID IN AQUEOUS ACIDIC PERCHLORATE MEDIA. Silverman, R. A.; Gordon, G. (Univ. of Iowa, Iowa City). Inorg. Chem.; 15: No. 1, 35-39 (Jan 1976).

The oxidation of uranium(IV) by hypochlorous acid has been studied in aqueous sodium perchlorate-perchloric acid solutions. The reaction $U^{4+} + 2HOCl$ equals $UO_2^{2+} + Cl_2(aq) + 2H^+$ proceeds appropriate to the rate law $-d[U(IV)]/dt$ equals $k_0 \cdot [U^{4+}][HOCl][H^+]^{-1}$. At 25^0 and 3 M ionic strength, k_0 is 1.08 +- 0.07 sec^{-1}. Over the 1-25^0 temperature range, DELTA H is 18.4 +- 0.1 kcal $mole^{-1}$, and DELTA S is 3.1 +- 0.4 eu. The inverse hydrogen ion dependence of the rate law is explained by a rapid preequilibrium, in which a proton is lost from one of the reactants. A uranyl-like activated complex, $[H_2UO_2Cl^{3+}]$, is suggested, with one proton likely to be residing on each oxygen atom. Evidence is presented that the mechanism involves a two-electron transfer, with the intermediate chloride ion rapidly reacting with hypochlorous acid to form chlorine. The uranium(IV)-hypochlorous acid reaction plays an important role in the oxidation of uranium(IV) by aqueous chlorine solutions. The magnitude of this role was seriously underestimated by previous investigators. (auth)

25503 THERMOCHEMISTRY OF URANIUM COMPOUNDS. V. Standard Enthalpies of Formation of the Monouranates of Lithium, Potassium, and Rubidium. O'Hare, P. A. G.; Hoekstra, H. R. (Argonne National Lab., IL). J. Chem. Thermodyn.; 6: 1161-1169(1974).

Enthalpies of reaction, DELTA H/sub r/, of the monouranates of lithium, potassium, and rubidium with 1 mol dm^{-3} HCl were measured calorimetrically as -(41.77 +- 0.02), -(42.07 +- 0.05), and -(41.30 +- 0.05) kcal/sub th//mol, respectively. From these measurements, and auxiliary determinations of the enthalpies of solution in acid of the chlorides of lithium, potassium, and rubidium and of uranyl chloride, the standard enthalpies of formation of the uranates, DELTA H^0/sub f/, have been derived as -(463.31 +- 0.84), -(451.39) +- 0.83), and -(452.00 +- 0.85) kcal/sub th//mol for alpha-Li_2UO_4, K_2UO_4, and Rb_2UO_4, respectively. The values of DELTA H/sub r/ and DELTA H^0/sub f/ differ significantly from those of the only previous study. (auth)

25504 THERMOCHEMISTRY OF URANIUM COMPOUNDS. IV. Standard Enthalpy of Formation of Sodium Uranium(V) Trioxide ($NaUO_3$). O'Hare, P. A. G.; Hoekstra, H. R. (Argonne National Lab., IL). J. Chem. Thermodyn.; 6: 965-972(1974).

A pure carefully characterized sample of sodium uranium(V) trioxide, $NaUO_3$, has been reacted in a calorimeter containing an aqueous mixture of HCl and XeO_3. Based on the enthalpy of reaction, the standard enthalpy of formation, DELTA H^0/sub f/($NaUO_3$, c, 298.15 K), has been determined to be -(357.5 +- 0.8) kcal/sub th/ mol^{-1}. Derived thermodynamic data attest to the significant stability of $NaUO_3$. (auth)

25505 THERMOCHEMISTRY OF URANIUM COMPOUNDS. VI. Standard Enthalpy of Formation of Cesium Diuranate ($Cs_2U_2O_7$). Thermodynamics of Formation of Cesium and Rubidium Uranates at Elevated Temperatures. O'Hare, P. A. G.; Hoekstra, H. R. (Argonne National Lab., IL). J. Chem. Thermodyn.; 7: 831-838 (1975).

Cesium diuranate, $Cs_2U_2O_7$, was reacted with 1 mol dm^{-3} HCl in a solution calorimeter. The enthalpy of reaction, -(46087 +- 102) cal/sub th/ mol^{-1}, leads to a standard enthalpy of formation, DELTA H^0/sub f/($Cs_2U_2O_7$, c, 298.15 K), of -(754.3 +- 1.6) kcal/sub th/ mol^{-1}. Thermodynamics of the Cs + U + O and Rb + U + O systems are discussed with particular emphasis on the formation of cesium and rubidium uranates and diuranates in nuclear reactor fuel. Formation of the monouranates is expected to predominate, although diuranates are also predicted to form, but in rather low concentrations. (auth)

25506 MÖSSBAUER SPECTRA AND MAGNETIC SUSCEPTIBILITY OF NEPTUNIUM TETRABROMIDE. Stevens, J.L.; Jones, E.R. Jr. (Department of Physics and Astronomy, University of South Carolina, Columbia, South Carolina 29208); Karraker, D.G. J. Chem. Phys. 64: No. 4, 1492-1494 (15 Feb 1976).

Magnetic properties of $NpBr_4$ were studied from 4.2 to 20.0 °K with the Mössbauer resonance of the 59.54-keV γ ray in ^{237}Np. Magnetic susceptibility was measured from 2.2 to 70.5 °K using a vibrating sample magnetometer at an applied field of 10 KOe. An antiferromagnetic transition was found at 12.5±0.5 °K. Above the Néel temperature, $NpBr_4$ obeys the Curie-Weiss law, $\chi = C/(T+\theta)$, with θ equal to 16.2 °K and an effective moment of 2.60 μ_B. The Mössbauer spectra exhibited magnetic hyperfine splitting over the temperature range 4.2 to 20 °K with $g_0\mu_n H_{eff} = 10.4$ cm/sec at 4.2 °K. A small decline in $g_0\mu_n H_{eff}$ was observed for temperatures above 12 °K. (auth)

25507 INFRARED SPECTRA OF MATRIX-ISOLATED UO^+_2 AND NO^-_2. Green, D.W.; Gabelnick, S.D.; Reedy, G.T. (Chemical Engineering Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439). J. Chem. Phys. 64: No. 4, 1697-1705 (15 Feb 1976).

The reactions of UO and UO_2 with NO and NO_2 have been studied by infrared spectroscopy using the matrix isolation technique. Codeposition of vaporized UO and UO_2 with NO_2 and with NO gases in an argon matrix at 14 K resulted in the production of the UO^+_2 molecular ion paired with either a NO^-_2 or NO^- anion. Three different reactions have been observed to yield a UO^+_2 cation product: (1) $UO_2 + NO_2$, (2) $UO_2 + NO$, and (3) $UO + NO_2$. Infrared absorption frequencies in the range 1150-1190 cm^{-1} have been measured and interpreted as the stretching modes of bent (bond angle = 109°) $N^{16}O^-_2$, $N^{16}O^{18}O^-$, and $N^{18}O^-_2$ ions paired with UO^+_2. Infrared absorption frequencies in the range 770-900 cm^{-1} have been measured and interpreted as the stretching modes of linear $U^{16}O^+_2$, $U^{16}O^{18}O^+$, and $U^{18}O^+_2$ paired with either NO^- or NO^-_2. (auth)

25508 PHYSICAL ADSORPTION OF 1,1,1-TRICHLOROETHANE ON URANIUM DIOXIDE. Stakebake, J. L. (Dow Chemical, Golden, CO). J. Catal.; 36: 463-470(1975).

Adsorption isotherms for 1,1,1-trichloroethane adsorption on uranium dioxide were obtained gravimetrically in the temperature range 0 to 30^{0}C. Adsorption data were evaluated using the BET and Clausius-Clapeyron equations and the potential theory of adsorption. The heat of adsorption was found to vary between 12 and 8 kcal/mole, depending upon the coverage. Using the BET equation the size of the adsorbed CH_3CCl_3 molecule was calculated to be 33 +- 5 A^2. (auth)

25509 DEZAKTIVATSIYA. (DEACTIVATION). Zimon, A. D. Moscow; Atomizdat (1975). 280p.

Problems of decontamination of objects contaminated with radioactive substances are examined. Topics discussed are the general concept of decontamination, methods for studying the deactivation process, mechanisms for the removal of radioactive contamination occurring both on the surface and within materials, principles for the selection and use of decontaminating solutions, and means of preventing or reducing contamination. An evaluation is given of the dangers of contamination. The required efficiency of decontamination is justified and the conditions for attaining it are determined. The methods for the decontamination of specific objects such as coatings, equipment, buildings, and districts are examined. (tr-auth)

25510 KRISTALLOKHIMICHESKIE ZAKONOMERNOSTI VO FTORIDAKH URANA I EGO ANALOGOV. (Crystallochemical

Laws on Uranium Fluorides and Their Analogs). Zadneprovskii, G. M.; Gagarinskii, Yu. V.; Borisov, S. V. Moscow; Atomizdat (1975). 44p.

Over seventy structures of uranium fluorides and their analog fluorides have been analyzed. The principal data on the forms of heavy cation coordination polyhedra and kinds of packing in crystal lattices have been generalized. The correlation between the shortest uranium–uranium distances and the mode of polyhedra bonding have been determined for uranium and other heavy metals. The equations that permit (from the dimensions of the ions which are the components of the polyhedra) the determination of the shortest interaction distances at various kinds of polyhedra packing are given. In the structures having columns or bands of polyhedra bonded through common faces or edges, respectively, the interdependence of cell dimensions and short metal–metal distances have been revealed. The analyses of interaction distances in structures with heavy multicharge cations is suggested as a new crystallochemical method for light anion localization in these structures. (auth)

25511 SYNTHESIS OF PENTAFLUORIDES. Asprey, L. B.; Paine, R. T. Jr. (to U. S. Energy Research and Development Administration). US Patent 3,929,601. B01J1/10. 30 Dec 1975. Filed date 26 Mar 1974. 4p.

PAT-APPL-454,983.

The reactions of uranium, molybdenum, rhenium, osmium and iridium hexafluorides with hydrogen gas in the presence of ultraviolet radiation or with silicon powder in an anhydrous HF slurry provide especially useful, high yield syntheses of pure pentafluorides.

25512 NONAQUEOUS ACTINIDE HYDRIDE DISSOLUTION AND PRODUCTION OF ACTINIDE beta-DIKETONATES. Crisler, L. R. (to U. S. Energy Research and Development Administration). US Patent 3,919,273. C07F5/00. 11 Nov 1975. Filed date 23 Aug 1974. 6p.

PAT-APPL-499,957.

Actinide beta-diketonate complex molecular compounds are produced by reacting a beta-diketone compound with a hydride of the actinide material in a mixture of carbon tetrachloride and methanol. (auth)

25513 NONAQUEOUS METHOD FOR DISSOLVING LANTHANIDE AND ACTINIDE METALS. Crisler, L. R. (to U. S. Energy Research and Development Administration). US Patent 3,919,274. C07F5/00. 11 Nov 1975. Filed date 23 Aug 1974. 6p.

PAT-APPL-499,960.

Lanthanide and actinide beta-diketonate complex molecular compounds are produced by reacting a beta-diketone compound with a lanthanide or actinide element in the elemental metallic state in a mixture of carbon tetrachloride and methanol.

25514 COLORIMETRIC STUDIES ON THE REACTION OF U(VI) AND Mo(VI) WITH 3,5-DICHLORO-2-HYDROXYACETOPHENONE AND ITS OXIME. Lal, K.; Gupta, S. P. (D. N. Coll., Meerut, India). Curr. Sci. (India); 45: No. 3, 84-85(5 Feb 1976).

Chelate formation of uranium and molybdenum with 3,5-dichloro-2-hydroxyacetophenone and its oxime have been studied. The mole-ratio (M : L) was found 1 : 2. The stability constant of these metal chelates at different ionic strength and their dielectric constants are calculated. (auth)

25515 VISCOSITY OF FUSED $CaCl_2$–UCl_3 MIXTURES. Desyatnik, V. N.; Raspopin, S. P.; Trifonov, K. I. J. Appl. Chem. USSR (Engl. Transl.); 48: No. 5, 1209-1210(May 1975).

Translated from Zh. Prikl. Khim.; 48: No. 5, 1157-1158(May 1975).

Study of the viscosity of fused mixtures of uranium trichloride and calcium chloride showed that as the result of differences in polarizing power of U^{3+} and Ca^{2+} cations complex $[UCl_5]^{2-}$ groups are apparently formed in the melt, containing Ca^{2+} cations in the second coordination sphere. With decreasing concentration of calcium chloride in the melt the number of $[CaCl_4]^{2-}$ complex groups decreases owing to appearance of $[UCl_5]^{2-}$ complex ions; this leads to a change of the melt structure. The accompanying change of viscosity is slight; in total absence of calcium chloride the melt viscosity increases. The form of the viscosity isotherm shows that complex groups are responsible for flow. (auth)

25516 RECOIL EMANATING POWER AND SPECIFIC SURFACE AREA OF SOLIDS LABELLED BY RADIUM RECOIL ATOMS. I. Theory for Single Solid Particles. Quet, C.; Rousseau-Violet, J.; Bussiere, P. (CNRS, Villeurbanne, France). Radiochem. Radioanal. Lett.; 23: No. 5-6, 359-368(19 Dec 1975).

The distribution of the radioactive precursor of the emanation is calculated for single solid particles (spheres, plates), labelled by nuclear recoil. The resulting recoil emanating power E_R^* is then expressed. For particles larger than the two considered recoil ranges, there is a linear relationship between E_R^* and the specific surface area. (auth)

25517 PREPARATION OF L-(U-^{14}C) LACTIC ACID FROM L-(U-^{14}C)ALANINE. Viswanathan, K. V.; Tamamurthy, T. V. (Bhabha Atomic Research Centre, Bombay). Radiochem. Radioanal. Lett.; 23: No. 5-6, 325-327(19 Dec 1975).

A method for the preparation of L-(U-^{14}C) lactic acid on submillimolar level using cation exchange resin in lieu of mineral or organic acids for liberating nitrous acid in the deamination reaction of L-(U-^{14}C) alanine is reported. The advantage of this method in the final purification is also described. (auth)

25518 VIBRATIONAL SPECTRA AND FORCE CONSTANTS OF UCl_6, UCl_5^-, AND $(UCl_5)_2$. Kolitsch, W.; Mueller, U. (Marburg Univ., Ger.). Z. Anorg. Allg. Chem.; 418: No. 3, 235-242(Dec 1975). (In German).

The infrared and Raman spectra of the title compounds are reported and assigned. For the octahedral UCl_6 and UCl_5^- a force constant calculation shows the U–Cl valency force constants to be 2.23 and 1.74 $N \cdot cm^{-1}$, respectively. For $(UCl_5)_2$ it was only possible to assign the valency vibrations of the terminal U–Cl groups which reasonable certainty; an estimation for their force constants leads to 2.0 $N \cdot cm^{-1}$. (auth)

25519 POSSIBILITY OF USING THE RADIOISOTOPE PALLADIUM-109 AS A TRACER FOR THE STUDY OF ITS UPTAKE BY OXYHYDRATE COLLECTORS. Chursin, G. P.; Shevelev, G. A.; Kochetkov, V. L.; Plotnikov, V. I.; Pilalova, L. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 27-31(1974). (In Russian).

All possible radioisotopes of Pd formed during the irradiation of natural mixtures by reactor neutrons were examined for their use as tracers during the study of coprecipitation processes. It was shown that ^{109}Pd was the most satisfactory and advantageous. (tr-auth)

25520 SOLUBILITY OF TETRAVALENT CERIUM IODATE. Posvol'skii, M. V.; Markov, G. S.; Fedorov, F. P. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 882-885(1974).

Translated from Radiokhimiya; 16: No. 6, 906-909(1974).

A study was made of the solubility of cerium (IV) iodate in solutions of a mixture of nitric and perchloric acids at $\mu = 5.6$. The relation of the solubility of cerium (IV) iodate to the concentration of iodate ions was determined and the values of $SP_{Ce(IO_3)_4}$ were calculated. (auth)

25521 NEPHELAUXETIC EFFECT IN SOLID AND MOLTEN HEXACHLOROAMERICIATE $Cs_2NaAmCl_6$. Barbanel, Yu. A.; Kotlin, V. P.; Chudnovskaya, G. P. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 867-870(1974).

Translated from Radiokhimiya, 16: No. 6, 889-894(1974).

As a result of an investigation of the absorption spectra of the hexachloroamericiate $Cs_2NaAmCl_6$ (sample thickness ~ 0.01 cm, temperature 25-720°C), it was shown that the octahedral coordination of the Am(III) is preserved on heating and also on melting of the salt. On the basis of the measurement of the nephelauxitic effect, the Am–Cl internuclear distances in molten and solid $Cs_2NaAmCl_6$ at different temperatures and also in molten pyridinium and alkali metal chlorides were determined. With respect to the magnitude of the nephelauxitic effect (0.8–1.6%) the chloride complexes of americium(III) lie between aqua and bromo complexes; the nephelauxitic series of ligands $F^- < H_2O < Cl^- < Br^- < I^- < C_5H_5$ corresponds to americium, like the d- and 4f-elements. Analysis of the magnitudes of the nephelauxitic effect corresponding to hexachloro complexes of lanthanides and americium makes it possible to propose that there is a nonmonotonic change in the f-co-valence in the series of f-transition elements and, in particular, there is an increase in it from americium to the elements at the beginning and at the end of the actinide series. (auth)

25522 REACTION OF POLONIUM VAPOR WITH ELEMENTS OF SUBGROUP IVA. Abakumov, A. S.; Ershova, Z. V. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 856-858(1974).

Translated from Radiokhimiya; 16: No. 6, 879-881(1974).

Polonium vapor does not react with silicon or zirconium and tantalum carbides. Polonium vapor reacts with tin at 370°C with the formation of a polonide which dissociates at 670°C. In the interaction of polonium vapor with Subgroup IVA elements (carbon-lead) there is a gradual change in properties, corresponding to the position of the element in the subgroup. The tendency of polonium to form polonides is lower than that of tellurium to form tellurides. (auth)

25523 STATE OF Pa(V) IONS IN THIOCYANATE SOLUTIONS. Nekrasova, V. V.; Pal'shin, E. S.; Myasoedov, B. F. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 851-855(1974).

Translated from Radiokhimiya; 16: No. 6, 873-878(1974).

A study was made of the behavior of $Pa^{(V)}$ in thiocyanate solutions by ion exchange, extraction, and electrophoresis methods and determination of the solubility. In thiocyanate solutions protactinium ions form anionic complexes at a lower concentration than in solutions of HCl and some other mineral acids. In the extraction process OH^- and SCN^- groups in the complex anion of $Pa^{(V)}$ may replace each other with the equilibrium shifted toward the extractable or sorbable complex. (auth)

25524 STABILITY OF THIOCYANATE COMPLEXES OF PROTACTINIUM(V). Nekrasova, V. V.; Pal'shin, E. S.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 11, 2267-2269(Nov 1975). (In Russian).

It has been shown by the solvent extraction method that indicator amounts of protactinium(V) can exist in acid thiocyanate solutions as monomers, at least for several months. At Pa(V) concentration $\geq 10^{-6}$ g-ion/l under such solutions, polymer compounds are formed in the course of time and the distribution coefficient for protactinium depends on its concentration. (auth)

25525 CARBONATE COMPOUNDS OF PENTAVALENT ACTINIDES WITH ALKALI METAL CATIONS. II. Preparation of Carbonate Compounds of Np(V), Pu(V), and Am(V) from K_2CO_3 Solution by Electrochemical Reduction of Hexavalent Ions. Simakin, G. A.; Volkov, Yu. F.; Visyashcheva, G. I.; Kapshukov, I. I.; Baklanova, P. F.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 838-841(1974).

Translated from Radiokhimiya; 16: No. 6, 859-863(1974).

The normal real potentials of the pairs $MeO_2^{2+} - MeO_2^+$ for Np, Pu, and Am in K_2CO_3 solutions were estimated as equal to 0.43, 0.30, and 0.90 V (n.h.e.), respectively. In the electrochemical reduction of hexavalent ions at a Pt electrode with a controlled potential two types of compound $KMeO_2CO_3 \cdot nH_2O$ (0.1-0.2 M K_2CO_3) and $K_3MeO_2(CO_3)_2 \cdot nH_2O$ (0.8-1.0 M K_2CO_3) were obtained. (auth)

25526 PREPARATION OF $NpO_3 \cdot 2H_2O$. Chaikhorskii, A. A.; Matuzenko, M. Yu.; Belyaev, Yu. I. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 829-831(1974).

Translated from Radiokhimiya; 16: No. 6, 850-853(1974).

Experiments for the preparation of $NpO_3 \cdot 2H_2O$ by the oxidation with ozone of aqueous suspensions of Np(V) hydroxide yielded products that contained considerable amounts of Np(VII). Results of experiments carried out under various conditions are tabulated. Oxidation of dry Np(V) hydroxides also yielded a product containing some of the higher valence Np. The change of the Np in the precipitate to a higher valent state with decreasing water content led to the conclusion that water molecules or OH groups play a decisive role in the oxidation of anionic compounds of Np(V) and Np(VI). (BLM)

25527 POLAROGRAPHIC PROPERTIES OF HIGHER OXIDATION STATES OF PLUTONIUM IN AQUEOUS ALKALI SOLUTIONS. Peretrukhin, V. F.; Alekseeva, D. P. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 823-828(1974).

Translated from Radiokhimiya; 16: No. 6, 843-849(1974).

It was shown that in alkali solutions containing more than 7M NaOH on a platinum electrode there occur two-stage polarographic reduction Pu(VII) → Pu(VI) → Pu(V) and oxidation Pu(V) → Pu(VI) → Pu(VII). The half-wave potentials of the reduction Pu(VII) → Pu(VI) and oxidation Pu(VI) → Pu(VIII) are shifted toward the cathode region with an increase in the alkali concentrations. It was shown that on a mercury cathode in 0.1 to 14M NaOH, there occurs the three-stage polarographic reduction of Pu(VI) → Pu(V) → Pu(IV) → Pu(III). From the experimental values of the half-wave potential, the formal potentials of plutonium pairs in 0.1-14M NaOH were determined. (auth)

25528 POLAROGRAPHIC PROPERTIES OF HIGHER OXIDATION STATES OF NEPTUNIUM IN AQUEOUS ALKALINE MEDIA. Peretrukhin, V. F.; Alekseeva, D. P. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 816-822(1974).

Translated from Radiokhimiya; 16: No. 6, 836-843(1974).

The polarographic properties of hepta-, hexa-, and pentavalent neptunium in 0.1-14 M NaOH were investigated. The change in the polarographic behavior of Np(VII), Np(VI), and Np(V) with a change from strong to dilute alkalis is explained by the change in forms of existence of the oxidation states of Np. (auth)

25529 ELECTROCHEMICAL PROPERTIES OF AMERICIUM HYDROXIDES IN AN AQUEOUS ALKALINE MEDIUM. Peretrukhin, V. F.; Nikolaevskii, V. B.; Shilov, V. P. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 813-815(1974).

Translated from Radiokhimiya; 16: No. 6, 833-836(1974).

The polarographic behavior of Am(V, VI) in alkaline medium was investigated. Estimates were made for the oxidation-reduction potentials of the corresponding couples, and the possibilities of the preparation of Am in the different oxidation states were investigated. In 5-10M NaOH, the polarograms of Am(VI) contained two waves: the first corresponds to the reduction of Am(VI) to Am(V), and the second, to the further reduction of Am(IV) to Am(III). The form of the waves was dependent upon the alkali concentrations. Am(III) was found to be electrolytically oxidized to the Am(V) and Am(III) under the conditions studied. (BLM)

25530 STABILITY OF HEXAVALENT AMERICIUM IN NITRIC ACID SOLUTIONS. Myasoedov, B. F.; Lebedev, I. A.; Frenkel, V. Ya.; Vyatkina, I. I. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 803-807(1974).

Translated from Radiokhimiya; 16: No. 6, 822-827(1974).

An investigation was made of the rate of reduction of $Am^{(VI)}$ in nitric acid solutions with an acidity from 10 M to pH = 6.0 with a concentration of ^{243}Am of $\sim 10^{-3}$-10^{-4} M, and the apparent rate constants of the reduction reaction were calculated. With an increase in the concentration of acid from 0.1 M HNO_3 to 10 M HNO_3 there is a change from a zero order reaction with respect to $Am^{(VI)}$ to a first order reaction, while the rate of reduction is decreased. In solutions with pH = 3.5-6.0 the rate of reduction of $Am^{(VI)}$ is increased markedly to 1-2% per min. (auth)

25531 DISPROPORTIONATION OF NEPTUNIUM(V) IN METHANOL. Aslanishvili, N. A.; Mefod'eva, M. P.; Krot, N. N. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 799-802(1974).

Translated from Radiokhimiya; 16: No. 6, 817-822(1974).

The disproportionation of neptunium (V) in a methanol solution of HCl was investigated spectrophotometrically. It was established that in contrast to aqueous solutions, in methanol the disproportionation of neptunium (V) proceeds at a lower concentration of acid. The reaction becomes irreversible at a hydrochloric acid concentration greater than 0.7 M. A study was made of the effect of water and the temperature on the rate of disproportionation of neptunium (V) in methanol. The activation energy was found to equal 15.8 kcal/mole. (auth)

25532 KINETICS OF OXIDATION OF AMERICIUM(III) BY PERSULFATE IONS IN SOLUTIONS OF AMMONIUM, SODIUM, AND POTASSIUM CARBONATES. Chistyakov, V. M.; Ermakov, V. A.; Mokruosov, A. D.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 793-798(1974).

Translated from Radiokhimiya; 16: No. 6, 810-817(1974).

The products from the oxidation of americium (III) by persulfate ions in solutions of ammonium, sodium, and potassium carbonates are americium (V) and americium (VI). The rate of oxidation of americium (III) in solutions of ammonium, sodium, and potassium carbonates is determined by the difference in the rates of thermal decomposition of persulfate ions and the accumulation of americium (VI). In solutions of ammonium and potassium carbonates with concentrations above 2 M there occurs the direct interaction of americium (III) with persulfate ions. The rate of oxidation of americium (III) by persulfate ions under otherwise identical conditions depends on the nature of the cation of the carbonate. A kinetic scheme is proposed for the oxidation of americium (III) by persulfate ions in solutions of ammonium, sodium, and potassium carbonates and this explains quantitatively the experimental data obtained. (auth)

25533 OXIDATION-REDUCTION REACTIONS OF ACTINIDES. XXIX. Kinetics of Neptunium(V)–Iron(II) Reaction in the Presence of Uranium(VI) and Indium(III) Ions. Rykov, A. G.; Frolov, A. A. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 786-792(1974).

Translated from Radiokhimiya; 16: No. 6, 803-810(1974).

A two-fold explanation for the change in the rate of reaction of Np(V)-Fe(II) in the presence of U(VI) and In(III) is presented. Spectrophotometric studies showed that an increase in the concentration of the "active" cations monotonically increased the fraction of Np(V) that is converted into the labile complexes. An additional "salt effect" is proposed. Under conditions where the "salt effect" was eliminated, the decrease in the rate of Np(V)-Fe(II) was proportional to the decrease in the fraction of free NpO_2^+ ions, indicating that the reaction proceeds by two parallel routes: (1) $NpO_2^+ + Fe^{2+} \rightarrow Np^{4+} + Fe^{3+}$ and (2) $(NpO_2^+)^* + Fe^{2+} \rightarrow Np^{4+} + Fe^{3+}$. The effective orders of reaction with respect to hydrogen ion concentration and the activation energies for routes (1) and (2) were determined. (BLM)

25534 PRODUCTS OF THE REACTION OF AQUEOUS SOLUTIONS OF URANYL NITRATE WITH AQUEOUS SOLUTIONS OF WEAK ORGANIC BASES. Lindval, R. V.; Kuznetsova, V. V. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 762-766(1974).

Translated from Radiokhimiya; 16: No. 6, 777-783(1974).

A study was made of the reaction of an aqueous solution of uranyl nitrate with aqueous solutions of pyridine and α-picoline.

Composition, color, and properties of the precipitate do not depend on the nature of the precipitant, but on the precipitation conditions. By chemical, thermographic, and thermogravimetric analysis methods and IR spectroscopy it was established that in the case of precipitation at 70 to 80°C the reaction product is hydrated uranyl hydroxide and in the case of precipitation at the boiling point of the solutions the reaction product is uranyl hydroxide. (auth)

25535 SYNTHESIS AND SOME PROPERTIES OF COMPLEX COMPOUNDS OF THORIUM AND URANYL WITH GLYCINE AND ASPARTIC AND GLUTAMIC ACIDS. Sergeev, G. M.; Korshunov, I. A. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 771-774(1974).

Translated from Radiokhimiya; 16: No. 6, 787-790(1974).

Complex compounds of Th and UO_2^{2+} with glycine, aspartic acid, and glutamic acid were prepared and characterized. All the compounds prepared were amorphous powders, which were stable in air and insoluble in the usual organic solvents. Some analysis of the structure of the compounds on the basis of IR spectral data were presented. The data agreed with cited references from similar studies that the coordination number of UO_2^{2+} in these compounds was 5, and that the coordination number of Th varied with different amino acids. (BLM)

25536 CARBONATE COMPOUNDS OF PENTAVALENT ACTINIDES WITH ALKALI METAL CATIONS. IV. X-ray Investigation of Dicarbonates of Neptunium(V), Plutonium(V), and Americium(V) with Potassium. Volkov, Yu. F.; Kapshukov, I. I.; Visyashcheva, G. I.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 846-850(1974).

Translated from Radiokhimiya; 16: No. 6, 868-873(1974).

On the basis of x-ray analysis it was established that dicarbonates of neptunium(V), plutonium(V), and americium(V) with the general formula $K_3XO_2(CO_3)_2 \cdot nH_2O$ crystallize in the form of two modifications (A and B), which belong to the rhombic syngony. The crystal lattice parameters were determined. It was shown that the water in the dicarbonates has a zeolite nature. The change in the crystal lattice parameters of the dicarbonates $KNpO_2(CO_3)_2 \cdot nH_2O$ of form A is connected with dehydration (on heating to 450°C) and hydration (in a moist atmosphere). For the dicarbonates $K_3NpO_2(CO_3)_2 \cdot nH_2O$ of form B no changes were observed in the crystal lattice parameters on heating and on wetting of the samples. At 450°C the phase transition B → A was recorded for the dicarbonate of neptunium(V). (auth)

25537 CARBONATE COMPOUNDS OF PENTAVALENT ACTINIDES WITH ALKALI METAL CATIONS. III. X-ray Investigation of Neptunium(V), Plutonium(V), and Americium(V) Monocarbonates with Potassium. Volkov, Yu. F.; Kapshukov, I. I.; Visyashcheva, G. I.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 842-845(1974).

Translated from Radiokhimiya; 16: No. 6, 863-867(1974).

X-ray analysis was used to investigate monocarbonates of pentavalent actinides with potassium, which have a hexagonal structure with the formula KXO_2CO_3, where X = Np(V), Pu(V), and Am(V), which was assigned to them previously. For this type of compound it was established that the crystal lattice parameters are variable and depend on the history of the samples, the synthesis conditions, the temperature, and the humidity. It was shown that in the general case the formula for the monocarbonates is $KXO_2CO_3 \cdot nH_2O$ ($n \lesssim 2$) with the insertion of water molecules into the crystal lattice as in zeolites. It was established that depending on the degree of hydration of the compounds, an anisotropic change is observed in the parameters of the hexagonal lattice; with a constant value of α, the parameter c for $KNpO_2CO_3 \cdot nH_2O$, $KPuO_2CO_3 \cdot nH_2O$, and $KAmO_2CO_3 \cdot nH_2O$ changes over the ranges of 9.87-10.23Å, 9.83-9.98Å, and 0.76-9.92Å, respectively. (auth)

25538 CARBONATE COMPOUNDS OF PENTAVALENT ACTINIDES WITH ALKALI METAL CATIONS. I. Composition and Some Properties of Solid Carbonates of Pentavalent Neptunium with Potassium Obtained from K_2CO_3 Solutions. Visyashcheva, G. I.; Volkov, Yu. F.; Simakin, G. A.; Kapshukov, I. I.; Bevz, A. S.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 832-837(1974).

Translated from Radiokhimiya; 16: No. 6, 853-859(1974).

By x-ray phase and chemical analyses it was established that a monocarbonate with the composition $KNpO_2CO_3 \cdot nH_2O$ ($n \lesssim 2$) is formed from aqueous solutions with a K_2CO_3 concentration up to 0.2 M. With higher concentrations of potassium carbonate a dicarbonate with the composition $K_3NpO_2(CO_3)_2 \cdot nH_2O$ ($n \lesssim 2$) separates. Three individual crystalline phases correspond to the mono- and dicarbonates: One of them corresponds to the monocarbonate, while the other two forms (B and A) are crystal modifications of the dicarbonate. No solid mixed hydroxocarbonate compounds of pentavalent neptunium and potassium were detected in the system studied. Neptunium monocarbonate decomposes at 430-440°C with the formation of a final two-phase product consisting of $KNpO_3$ and $K_2Np_2O_7$. The decomposition of forms B and A of the dicarbonate begins at an appreciable rate at 500°C and is accompanied by a clear endothermic effect at 636°C (form B) and 584°C (form A). It was established by x-ray analysis that one phase, K_2NpO_4, is formed when these forms are heated to 900°C. (auth)

25539 COMPLEX FORMATION OF URANIUM(IV) IN SOLUTIONS OF AMINO ACIDS. Sergeev, G. M.; Korshunov, I. A. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 767-770(1974).

Translated from Radiokhimiya; 16: No. 6, 783-787(1974).

The composition and stability constants of the complexes of U(IV) with a series of amino acids were determined by a spectrophotometric method. Only two individual absorption spectra were noted under the conditions studied. One spectrum was attributed to U(IV) in the aqueous and the other to an equimolar complex. The experimental data were to fit a theoretical model for an equimolar complex, and it is assumed that in complex formation addition of the carboxyl group of the amino acid occurs with subsequent ring closure through the N atom. The possibility of the separation of the different elements or groups of elements, Th, U, tri- and pentavalent actinides, other rare earth elements, Zr, and Hf, based on stability of complexes with different amino acids is pointed out. (BLM)

25540 THERMOGRAPHIC AND X-RAY INVESTIGATION OF THE BINARY SYSTEMS $ThCl_4$–LiCl AND $ThCl_4$–NaCl. Vdovenio, V. M.; Gershanovich, A. Ya.; Suglobova, I. G. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 863-866(1974).

Translated from Radiokhimiya, 16: No. 6, 886-889(1974).

A thermographic investigation of the binary systems $ThCl_4$–LiCl and $ThCl_4$–NaCl showed that in these systems there are formed the complex compounds Li_4ThCl_8 and $NaThCl_5$, which melt incongruently at 445 and 394°C, respectively. X-ray analysis of the systems confirmed the results of the thermogravimetric investigation and gave the diffraction patterns of the compounds Li_4ThCl_8 and $NaThCl_5$. (auth)

Radioactive Waste Treatment

Refer also to abstracts 25397 and 26114.

25541 (AD/A-006694) PURIFICATION OF GASEOUS DISCHARGES OF RADIOACTIVE AEROSOLS AND GASES. Przyborowski, S. 18 Feb 1975. Edited Translation of Staatliche Zentrale fuer Strahlenschutz, Berlin, Report (East Germany), SZS-142, p15-19, Sep 1972. (FTD-HC-23-0750-75). 10p, NTIS $3.25.

The importance of a thorough testing of filter material used for the removal of aerosols from the exhaust air of nuclear power plants is noted. A method is presented for the assessment of penetration depending on particle size and flow rate. The results obtained are discussed. (GRA)

25542 (BNWL-1949) RESEARCH AND DEVELOPMENT ACTIVITIES WASTE FIXATION PROGRAM. Quarterly Progress Report, July–September 1975. McElroy, J. L. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-1830. 87p. Dep. NTIS $6.00.

Engineering-scale in-canister melting tests were made to evaluate the use of silicon to prevent formation of water-soluble molybdate phases in melts. The tests demonstrated that silicon metal powder added to the feed stock effectively prevents formation of such phases. A test also showed that coatings of ZrO_2 or chromium carbide on stainless steel canisters prevent oxidation during the in-can melting process. Tests of the spray calciner demonstrated very effective removal of scale by the barrel vibrators. In one run using a larger feed nozzle, a processing capacity exceeding 75 l/hr was achieved. Thermal analysis of canister design concepts examined effects of type of storage, use of fins, emissivity, canister size and cracks in glass. Pressurization tests show that all types of calcine can produce very high pressures within the canister unless the calcine is post-treated at temperatures greater than 850°C. Electrical conductivity measurements of glass frit with and without simulated waste additions were performed. Initial studies on the effects of alpha and recoil bombardment (from ^{244}Cm doping) on devitrification of waste-containing glass were completed. The devitrification behavior of a waste-bearing zinc orthosilicate glass is being studied using optical microscopy, electron microprobe, and x-ray diffraction examination. Fine calcine particles were agglomerated into larger particles suitable for coating via chemical vapor deposition. Thermal stability tests of nickel and Cr_7C_3 coatings on waste calcine have been conducted, and deterioration has occurred at

temperatures as low as 500°C. Waste-containing pellets were successfully coated by plasma spraying Al_2O_3 powder. Calculations indicate that plasma spraying of large pellets is feasible on a production scale. Seven scoping runs made with a disc pelletizer indicate that it can provide a simple, inexpensive process for making high-quality pellets from calcine-frit powders. Risk assessment was used to systematically identify dominant sequences for the accidental release of radionuclides during the solidification, basin storage, and rail transport activities of high-level waste management. (JGB)

25543 (CEA-CONF-3140) STATEMENT OF RESEARCH IN THE FIELD OF SOLIDIFICATION OF HIGH LEVEL RADIOACTIVE WASTES IN FRANCE. Bonniaud, R.; Sombret, C. (CEA Centre de Marcoule, 30-Bagnols-sur-Ceze (France)). 1975. 30p. INIS.

From 77th annual meeting of the American Ceramic Society; Washington, USA (3 May 1975).

Research undertaken in France on the solidification of fission products are presented. Examples of glass compositions suitable for several types of fuels are given. The irradiation effects, crystallization, leaching and effects of α emitters have been studied. Two processes, one discontinuous, the other continuous have been studied and developed. In Marcoule, a continuous vitrification plant is under construction and an experimental air-cooling storage is being carried out. (FR)

25544 (SAND-75-5907) SANDIA SOLIDIFICATION PROCESS: A BROAD RANGE AQUEOUS WASTE SOLIDIFICATION METHOD. Lynch, R. W.; Dosch, R. G.; Kenna, B. T.; Johnstone, J. K.; Nowak, E. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1976. 15p. (CONF-760310-1; SM-207/75). Dep. NTIS $3.50.

From IAEA symposium on the management of radioactive waste; Vienna, Austria (22 Mar 1976).

New ion-exchange materials of the hydrous oxide type were developed for solidifying aqueous radioactive wastes. These materials have the general formula M[M'/sub x/O/sub y/H/sub z/]/sub n/, where M is an exchangeable cation of charge -n and M' may be Ti; Nb; Zr, or Ta. Affinities for polyvalent cations were found to be very high and ion-exchange capacities large (e.g., 4.0-4.5 meq/g for $NaTi_2O_5H$ depending on moisture content). The effectiveness of the exchangers for solidifying high-level waste resulting from reprocessing light-water reactor fuel was demonstrated in small-scale tests. Used in conjunction with anion exchange resin, these materials reduced test solution radioactivity from approximately 0.2 Ci/ml to as low as approximately 2 nCi/ml. The residual radioactivity was almost exclusiveiy due to ^{106}Ru and total alpha-activity was only a few pCi/ml. Alternative methods of consolidating the solidified waste were evaluated using nonradioactive simulants. Best results were obtained by pressure-sintering which yielded essentially fully dense ceramics, e.g., titanate/titania ceramics with bulk density as high as 4.7 g/cm^3, waste oxide content as high as 1.2 g/cm^3, and leach resistance comparable to good borosilicate glass. Based on the above results, a baseline process for solidifying high-level waste was defined and approximate economic analyses indicated costs were not prohibitive. Additional tests have demonstrated that, if desired, operating conditions could be modified to allow recovery of radiocesium (and perhaps other isotopes) during solidification of the remaining constituents of high-level waste. Preliminary tests have also shown that these materials offer promise for treating tank-stored neutralized wastes. (auth)

25545 IMPROVED METHOD FOR SOLIDIFYING LIQUID RADIOACTIVE WASTES. Berreth, J. R. (to U.S. Energy Research and Development Administration). US Patent Application 567,340. Filed date 11 Apr 1975. 7p.

The quantity of nitrous oxides produced during the solidification of liquid radioactive wastes containing nitrates and nitrites can be substantially reduced by the addition to the wastes of a stoichiometric amount of urea which, upon heating, destroys the nitrates and nitrites, liberating nontoxic N_2, CO_2 and NH_3. (auth)

25546 ACTIVATION OF WATER SOLUBLE AMINES BY HALOGENS FOR TRAPPING RADIOIODINE FROM AIR STREAMS. Deitz, V. R.; Blachly, C. H. (to U.S. Energy Research and Development Administration). US Patent Application 570,925. Filed data 22 Apr 1975. 7p.

Gas adsorbent charcoals impregnated with an aqueous solution of the reaction product of a tertiary amine and elemental iodine or bromine are better than 99 percent efficient in trapping $CH_3{}^{131}I$. The chemical addition of iodine or bromine to the tertiary amine molecule increases the efficiency of the impregnated charcoal as a trapping agent, and in conjunction with the high flash point of the tertiary amine raises the ignition temperature of the impregnated charcoal. (auth)

25547 IODINE RETENTION DURING EVAPORATIVE VOLUME REDUCTION. Godbee, H. W.; Cathers, G. I.; Blanco, R. E. (to U. S. Energy Research and Development Administration). US Patent 3,920,577. C09K11/04. 18 Nov 1975. Filed date 16 Jul 1974. 4p.

PAT-APPL-489,791.

An improved method for retaining radioactive iodine in aqueous waste solutions during volume reduction is disclosed. The method applies to evaporative volume reduction processes whereby the decontaminated (evaporated) water can be returned safely to the environment. The method generally comprises isotopically diluting the waste solution with a nonradioactive iodide and maintaining the solution at a high pH during evaporation.

25548 METHOD FOR CONDITIONING RADIOACTIVE WASTE. Cuaz, D.; Thiery, D. (to CEA, 75- Paris (France)). French Patent 2,230,041/E/. 17 May 1973. 4p. (In French).

Description is given of a method for conditioning radioactive waste according to the main patent, characterized in that contaminated organic substances are added to the polymerizable resin prior to adding the radioactive dry powder. This can be applied to the treatment of radioactive effluents in the nuclear field. (FR)

Radioisotope Production

Refer also to abstracts 25404 and 25405.

25549 GAS PRODUCTION APPARATUS AND METHOD. Winsche, W. E.; Miles, F. T.; Powell, J. R. (to U.S. Energy Research and Development Administration). US Patent Application 560,430. Filed date 20 Mar 1975. 13p.

This invention relates generally to the production of gases, and more particularly to the production of tritium gas in a reliable long operating lifetime systems that employs solid lithium to overcome the heretofore known problems of material compatibility and corrosion, etc., with liquid metals. The solid lithium is irradiated by neutrons inside low activity means containing a positive pressure gas stream for removing and separating the tritium from the solid lithium, and these means are contained in a low activity shell containing a thermal insulator and a neutron moderator. (auth)

25550 RADIOACTIVE MATERIAL GENERATOR. Czaplinski, T. V.; Bolter, B. J.; Heyer, R. E.; Bruno, G. A. (to E. R. Squibb and Sons, Inc.). US Patent 3,920,995. 18 Nov 1975. Filed date 20 May 1974. 10p.

A radioactive material generator includes radioactive material in a column, which column is connected to inlet and outlet conduits, the generator being embedded in a lead casing. The inlet and outlet conduits extend through the casing and are topped by pierceable closure caps. A fitting, containing means to connect an eluent supply and an eluate container, is adapted to pierce the closure caps. The lead casing and the fitting are compatibly contoured such that they will fit only if properly aligned with respect to each other. (Official Gazette)

25551 DUAL TEMPERATURE CONCENTRATION SYSTEM. Spevack, J. S. (to Deuterium Corp.). US Patent 3,920,395. 18 Nov 1975. Filed date 26 Sep 1966. 12p.

In a dual temperature isotope exchange system—exemplified by exchange of deuterium and protium between water and hydrogen sulfide gas in hot and cold towers, in which the feed stream (water) containing the desired isotope is passed through a pair of towers maintained at different temperatures wherein it effects isotope exchange with countercurrently circulated auxiliary fluid (H_2S) and is impoverished in said isotope and then disposed of, e.g. discharged to waste,—the flow of isotope enriched auxiliary fluid between said towers (hot H_2S saturated with water vapor) is divided and a part thereof is adjusted in its temperature (to cold tower conditions) and then passed to the auxiliary fluid impoverishing (cold) tower, while the remainder of the divided flow of such enriched auxiliary fluid is passed through a subsequent isotope concentration treatment to produce a product more highly enriched in the desired isotope and wherein it is also adjusted in its temperature and is impoverished in said isotope during said subsequent treatment before it is delivered to the said auxiliary fluid impoverishing (cold) tower. Certain provisions are made for returning to the hot tower liquid carried as vapor by the remainder of the divided flow to the subsequent isotope concentration treatment, for recovering sensible and latent heat, and for reducing passage of auxiliary fluid to waste. (Official Gazette)

25552 OBSERVATIONS ON THE PRODUCTION AND QUALITY CONTROL OF RADIOISOTOPE ^{18}F. Gulbaba, T. (Cekmece Nuclear Research and Training Centre, Istanbul). Radiochem. Radioanal. Lett.; 24: No. 1, 31-34(15 Jan 1976).

Fluorine-18 is produced by neutron irradiation of lithium carbonate and is separated by dissolving the material in acid and distilling the hydrogen fluoride solution. The yield is better than 80%,

radioactive impurities less than 1% and the residual tritium content is less than 0.1 μCi. (auth)

25553 CYCLOTRON PRODUCTION OF ^{123}Xe AND HIGH PURITY ^{123}I: A COMPARISON OF TELLURIUM TARGETS. Guillaume, M.; Lambrecht, R. M.; Wolf, A. P. (Brookhaven National Lab., Upton, NY). Int. J. Appl. Radiat. Isot.; 26: No. 12, 703-707(1975).

Cyclotron production of ^{123}Xe from isotopically enriched tellurium targets was evaluated as a source of high-purity ^{123}I for radiopharmaceutical applications. The ^{123}Te(^{3}He, 3n)^{123}Xe and the ^{124}Te(^{3}He, 4n)^{123}Xe nuclear reactions have cross section peaks of 178 mb and 162 mb at 26 MeV and 45 MeV, respectively. The ^{123}Xe thick target production yields for the reactions were 6.44 mCi/μAhr and 7.16 mCi/μAhr, respectively, as compared to >5 mCi/μAhr for the ^{122}Te(^{4}He, 3n)^{123}Xe reaction. The radionuclidic impurity of ^{125}I in the ^{123}I can be kept to ≤0.2% in all cases. Considering the production yield and the cost per mg of enriched ^{124}Te, the ^{124}Te(^{3}He, 4n)^{123}Xe reaction is acceptable, although it has not been used in the past. (auth)

25554 PRODUCTION OF ^{123}I FOR MEDICAL PURPOSES AT THE MILAN AVF CYCLOTRON. Acerbi, E.; Birattari, C.; Castiglioni, M.; Resmini, F. (Univ., Milan). Int. J. Appl. Radiat. Isot.; 26: No. 12, 741-747(1975).

A method is described for the production of large quantities of ^{123}I by exciting a (p, 2n) reaction on enriched ^{124}Te targets. Results are presented for the relevant excitation functions. The irradiation technique and the chemical processes used in the separation of ^{123}I and the recovery of the target material are described. (auth)

25555 CYCLOTRON PRODUCTION OF ^{38}S BY THE REACTION ^{40}Ar (p,3p) ^{38}S. Leurs, C. J.; Kremer, L. N.; Boersma, J.; Lindner, L. (Institut voor Kernphysisch Onderzoek, Amsterdam). Int. J. Appl. Radiat. Isot.; 26: No. 12, 771-773(1975).

The production of ^{38}S, by the reaction ^{40}Ar(p, 3p)^{38}S using a 52-MeV synchrocyclotron proton beam, is reported. Recovery of the ^{38}S, both as wall-activity deposited during irradiation on the inside of the irradiation vessel in the form of sulfate and as gas phase activity by a recoil-labelling process, is described. (UK)

25556 RADIOCHEMICAL SEPARATION OF ZINC AND GALLIUM. Brodskaya, G. A.; Gureev, E. S.; Usachenko, V. S.; Urazaeva, N.; Zolotov, Yu. A. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 886-889(1974).

Translated from Radiokhimiya; 16: No. 6, 909-913(1974).

An investigation was made of the extraction of zinc and gallium from hydrochloric acid media with solutions of dihexyl sulfoxide and petroleum sulfoxides in toluene in relation to the concentration of HCl, sulfoxides, and the metal. Extraction chromatography methods were developed for the separation of macro- and microamounts of zinc and gallium. The extraction chromatography variant with petroleum sulfoxides was used for the preparation of the carrier-free radioactive isotopes ^{66,67}Ga from zinc irradiated with protons. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 26894, 28036, 28221, and 28252.

25557 (DOCKET-50201-174) WEST VALLEY REPROCESSING PLANT. Safety Analysis Plant, Supplement 18. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 14 Nov 1975. 66p. Dep. NTIS $4.50.

Supplement 18 contains the following additions to Appendix II-5.0 Geology and Seismology: Section 12 "Seismic Investigations for Spent Fuel Reprocessing Facility at West Valley, New York," October 20, 1975, and Section 13 "Earthquake Return Period Analysis at West Valley, New York, for Nuclear Fuel Services, Inc." November 5, 1975. (LK)

25558 (DOCKET-701729-7) FUEL RECEIVING AND STORAGE STATION. Nuclear Regulatory Commission's Final Environmental Statement. (Allied-General Nuclear Services, Barnwell, S. C. (USA)). Jan 1976. 189p. (NUREG-0008). Dep. NTIS $7.50.

The following items are covered: the site, the station, environmental effects of site preparation and station construction, environmental effects of station operation, effluent and environmental monitoring programs, environmental effects of accidents, need for BFRSS, benefit-cost analysis of alternatives, generic environmental impact statements, and discussion of and response to comments received on the draft environmental statement. (LK)

25559 (ORNL-5078, pp 140-162) FUEL PROCESSING FOR MOLTEN-SALT REACTORS. Hightower, J. R. Jr. Feb 1976.

In molten-salt reactor program. Semiannual progress report for period ending August 31, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Research devoted to development of processes for the isolation of protactinium and for the removal of fission products from molten-salt breeder reactors is reported. During this report period, engineering development progressed on continuous fluorinators for uranium removal, the metal transfer process for rare-earth removal, the fuel reconstitution step, and molten salt-bismuth contactors to be used in reductive extraction processes. The metal transfer experiment MTE-3B was started. In this experiment all parts of the metal transfer process for rare-earth removal are demonstrated using salt flow rates which are about 1 percent of those required to process the fuel salt in a 1000-MW(e) MSBR. During this report period the salt and bismuth phases were transferred to the experimental vessels, and two runs with agitator speeds of 5 rps were made to measure the rate of transfer of neodymium from the fluoride salt to the Bi-Li stripper solution. The uranium removed from the fuel salt by fluorination must be returned to the processed salt in the fuel reconstitution step before the fuel salt is returned to the reactor. An engineering experiment to demonstrate the fuel reconstitution step is being installed. In this experiment gold-lined equipment will be used to avoid introducing products of corrosion by UF_6 and UF_5. Alternative methods for providing the gold lining include electroplating and mechanical fabrication. (JRD)

25560 NUCLEAR FUEL CYCLE. A Survey of the Public Health, Environmental, and National Security Effects of Nuclear Power. MIT Press Environmental Studies Series. Cambridge, MA; Massachusetts Institute of Technology Press (1975). 307p. MIT Press, 28 Carleton Street, Cambridge, MA 02142, $4.95.

The following aspects of the nuclear fuel cycle are discussed: radiation-induced lung cancers among uranium miners; radiation hazards associated with uranium mill operations; catastrophic nuclear reactor accidents; nuclear safeguards problem; transportation of radioactive wastes—possibility of release of cesium; nuclear fuel reprocessing—radiological impact of West Valley plant; and storage and disposal of high-level radioactive wastes. (LK)

25561 IRRADIATED FUEL CYCLE. I. Franklin, N. L. (British Nuclear Fuels Ltd., Risley, Eng.). J. Br. Nucl. Energy Soc.; 14: No. 4, 273-285(Oct 1975).

From 1st European Nuclear Society international conference on nuclear energy maturity; Paris, France (21 Apr 1975).

The present status of the reprocessing industry is reviewed in its widest context and the following are discussed: general objectives of the industry, evolution of processes and equipment, safety procedures, radioactive waste management, the construction of reprocessing plants, transport of radioactive materials, and commercial organization and funding. In conclusion future prospects are reviewed. (auth)

25562 VOLATILIZATION OF IODINE FROM NITRIC ACID USING PEROXIDE. Cathers, G. I.; Shipman, C. J. (to U. S. Energy Research and Development Administration). US Patent 3,914,388. C01F13/00. 21 Oct 1975. Filed date 11 Sep 1973. 4p. PAT-APPL-396,336.

A method for removing radioactive iodine from nitric acid solution by adding hydrogen peroxide to the solution while concurrently holding the solution at the boiling point and distilling hydrogen iodide from the solution is reported.

25563 METHOD FOR TREATING IRRADIATED FUELS SO AS TO RESTRICT THE DISPOSAL OF TRITIUM INTO THE ENVIRONMENT. Bernard, C. (to Saint-Gobain- Techniques Nouvelles, 92- Courbevoie (France)). French Patent 2,230,040/A/. 18 May 1973. 19p. (In French).

The invention relates to a method for separating tritium in a fuel reprocessing plant, according to which the fuels are first dissolved in nitric acid, then the solution obtained is submitted to extraction and washing operations. The method is characterized in that after a first extraction of the irradiated fuels from the solution and a first washing of the organic phase issued from the extraction step with an aqueous washing solution containing tritiated water, the organic phase is submitted to a second washing step with a dilute nitric acid solution free from tritium, the flow rate of which is substancially smaller than that of the organic phase, with a view to re-extracting the tritiated water dissolved in the solvent and to avoiding contamination by tritium in the subsequent steps of the method. (FR)

25564 A METHOD FOR PREPARING HYDROXYLAMINE FORMIATE. Bathellier, A.; Germain, M. (to CEA, 75- Paris (France)). French Patent 2,229,675/A/. 18 May 1973. 5p. (In French).

This method is characterized in that an anion exchange is carried out between an aqeuous solution of hydroxylamine salt, and an organic solution of a formiate of a water insoluble amine, according the following reaction: NH_2OH, HXaq + A, HCOOHorg → A, HXorg + NH_2OH, HCOOaq in which A is the water insoluble amine and X is the anion of the starting hydroxylamine salt. This can be applied to the nuclear fuel reprocessing methods. (FR)

CONTROLLED THERMONUCLEAR RESEARCH

25565 (AD/A-006670) SEMIANNUAL STATUS REPORT No. 125, 1 JULY THROUGH 31 DECEMBER 1973. (Stanford Univ., Calif. (USA). Stanford Electronics Labs.). 31 Dec 1973. Contract N00014-67-A-0112-0044. 106p. (SU-SEL-73-051). NTIS $5.25.

See also report dated 31 Dec 1972, AD-759697.

Progress is reported on: plasma physics and quantum electronics; radioscience; integrated circuits; Solid-state physics; information systems; and digital systems. (GRA)

25566 (PB-238901) REPORT OF NRL PROGRESS. (Naval Research Lab., Washington, D. C. (USA)). Nov 1974. 46p. NTIS $3.75.

Progress of the Plasma physics division is reported. Progress notes are also included on: acoustics, fracture mechanics, magnetic materials, mathematics, metallurgy, ocean technology, radio and radar, space science, space systems, and supporting techniques. Papers by NRL staff members and patents are listed. (GRA)

25567 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 9, No. 12, 1975. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 50p.

25568 PLASMA PHYSICS INDEX. Volume 11, No. 1, 1976. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 120p.

25569 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 10, No. 1, 1975. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 45p.

25570 PLASMA PHYSICS INDEX. Volume 10, No. 12, 1975. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 163p.

Plasma Confinement and Heating

25571 (AD/A-006111) PROPAGATION OF HIGH-POWER LASER RADIATION IN PARTIALLY IONIZED GASES. Physical Sciences Research Papers. Papa, R. J.; Taylor, R. L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 23 Oct 1974. 80p. (AFCRL-PSRP-607; AFCRL-TR-74-0532). NTIS $4.75.

When a laser beam of sufficiently high intensity interacts with a weakly ionized gas, the nonuniform deposition of laser energy into the electron gas causes heating of the electrons, ions, and neutral gas. Eventually, the neutral gas will "break-down" and become more highly ionized. This ionization can seriously limit the amount of laser energy that can damage a target. A multifluid model has been devised to describe the many physical processes that occur when the high-power laser wave interacts with the partially ionized gas. A flexible computer program has been developed to numerically integrate the multifluid plasma transport equations coupled with Maxwell's equations. The computer program is sufficiently general so as to be capable of describing target vaporization, with diffusion and ionization of target material into an ambient gas. In this report, only the modification of an ambient gas by the laser radiation is studied. (GRA)

25572 (COO-2180-7) STUDIES OF CHARGED PARTICLE DISTRIBUTIONS IN AN ELECTROSTATIC CONFINEMENT SYSTEM. Progress Report, 1 November 1971-31 January 1976. Gardner, A. L. (Brigham Young Univ., Provo, Utah (USA). Dept. of Physics and Astronomy). 1976. Contract AT(11-1)-2180. 14p. Dep. NTIS $3.50.

Microwave cavity techniques were used to measure electron density in a spherical, inertial-electrostatic confinement device using six ion guns. The density was roughly proportional to ion current (1 to 17 mA) and decreased somewhat with increasing ion energy (10 to 37 keV). With D_2 pressure decrease from 10 to 3 mTorr, n/sub e/ decreased faster than linearly and below approximately 3 mTorr decreased linearly with pressure down to the lowest pressure of 0.4 mTorr. At 1 mTorr and 10 mA, measurements (with poor spatial resolution) were consistent with 10^{10} total electrons and a central n/sub e/ of 10^9 electrons/cm^3. Neutron flux (at 50 keV) was about one sixth that of Hirsch (J. Appl. Phys. 38, 4522 (1967)). Six- vs. three-gun operation showed a small enhancement of both n/sub e/ and neutron flux that may indicate some particle trapping.

25573 (EUR-CEA-FC-780) NUMERICAL STUDY OF SOME ENERGY RECUPERATION METHODS IN INJECTORS OF NEUTRAL BEAM. Raimbault, P. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1975. 53p. (In French). INIS.

In order to produce neutral beams for fusion plasmas efficiently, the energy contained in the unneutralized fraction of the beam coming from the ion source, has to be recovered. Several recovery systems using electrostatic deceleration are proposed. To prevent heating damages, the presence of obstacles on the neutral beam trajectories had to be reduced to a minimum. A computer code permitted to determine the importance of geometrical factors and space charge effects in designing the optimum configuration. (FR)

25574 (LBL-3399(Suppl.), pp VI.2.1-VI.2.9) EUROPEAN RESEARCH AND DEVELOPMENT FOR NEUTRAL INJECTION INTO FUSION EXPERIMENTS. Thompson, E. (UKAEA, Oxfordshire, Eng.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The performance of existing neutral injectors presently being used in Europe for plasma heating and production in controlled thermonuclear research is reviewed. The physical and technical problems associated with extending present systems to the MW power level for next generation experiments are also discussed. (auth)

25575 (MATT-1172) HIGH FREQUENCY PARAMETRIC WAVE PHENOMENA AND PLASMA HEATING: A REVIEW. Porkolab, M. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. Contract E(11-1)-3073. 70p. (CONF-750877-2). Dep. NTIS $4.50.

From 12th international conference on phenomena in ionized gases; Eindhoven, Union of Soviet Socialist Republics (USSR) (Aug 1975).

A survey of parametric instabilities in plasma, and associated particle heating, is presented. A brief summary of linear theory is given. The physical mechanism of decay instability, the purely growing mode (oscillating two-stream instability) and soliton and density cavity formation is presented. Effects of density gradients are discussed. Possible nonlinear saturation mechanisms are pointed out. Experimental evidence for the existence of parametric instabilities in both unmagnetized and magnetized plasmas is reviewed in some detail. Experimental observation of plasma heating associated with the presence of parametric instabilities is demonstrated by a number of examples. Possible application of these phenomena to heating of pellets by lasers and heating of magnetically confined fusion plasmas by high power microwave sources is discussed. (auth)

25576 (ORNL-tr-4080) PLASMA HEATING IN THE TM-3 TOKAMAK AT ELECTRON-CYCLOTRON RESONANCE WITH MAGNETIC FIELDS UP TO 25 ke. Alikaev, V. V.; Bobrovskii, G. A.; Poznyak, V. I.; Razumova, K. A.; Sannikov, V. V.; Sokolov, Yu. A.; Shmarin, A. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. Translation by S. D. Blalock Jr. of IAE-2564. 8p. Dep. NTIS $3.50.

Experiments were conducted in heating plasma at electron-cyclotron resonance (ECR) with longitudinal magnetic fields up to 25 ke. It was shown by the aid of laser diagnosis that the temperature of the basic component of the electrons increases in accordance with the classical mechanism of heating at ECR in the process of electron-cyclotron heating (ECH). The distribution of the temperature of electrons with respect to radius was measured. The relationship of energetic lifetime in the Tokamak and electron temperature was obtained and the magnitude of energetic lifetime of accelerated electrons in the function of their energy was estimated. The value beta/sub tau/ approximately equal to 2.2 was obtained by the aid of ECH in a regime with small discharge currents.

25577 (ORO-4338-8) CONTINUATION OF INVESTIGATION OF TURBULENT HEATING SCHEMES. Annual Progress Report. Jones, W. D.; Oleson, N. L. (University of South Florida, Tampa (USA)). 24 Feb 1976. Contract AT(40-1)-4338. 36p. Dep. NTIS $4.00.

In the past year, the linear turbulent-heating device was modified and improved, three new major diagnostic systems were put into operation, and most important of all, the catalytic turbulent-heating by spatial magnetic field variations was successfully demonstrated. One basic goal is to increase the efficiency of coupling energy into low frequency modes which in turn heat the ions selectively. The experimental results strongly indicate this is the case. It is conceivable that ion heating can be improved by the presence of either intentional or unavoidable magnetic field variations.

25578 (RT/FIMA-(75)4) NUMERICAL INVESTIGATION OF TOROIDAL AXISYMMETRIC FREE-BOUNDARY EQUILIBRIA WITH EXTERNAL CONDUCTORS. Cenacchi, G.; Galvao, R.; Taroni, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy); Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1975. Contract EA(11-1)-3070. 55p. Dep. NTIS $4.50.

An extensive numerical study of magnetic confinement configurations with noncircular cross sections is described. The plasma column is kept in equilibrium by a conducting shell or by currents flowing in external conductors, without the shell. The stability of the equilibrium configurations against localized flute modes is tested by using the Mercier criterion. The possibility of obtaining stable equilibria at low aspect ratios ($R/a \sim 2$) is demonstrated. It is also shown that non-circular cross section devices with fairly large plasma currents ($I_p \sim 2$MA) can be constructed without a shell to keep the plasma in equilibrium.

25579 (TID-27002) PLASMA HEATING WITH A ROTATING RELATIVISTIC ELECTRON BEAM. I. Return Current Processes. Molvig, K.; Rostoker, N. (California Univ., Irvine (USA). Dept. of Physics; Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 1974. Contract AT(04-3)-34. 55p. Dep. NTIS $4.50.

An advantageous configuration for plasma heating with a relativistic beam utilizes an annular beam rotating about a guide magnetic field. In this first paper (of two), the return current process for such a configuration is considered. For the parameters expected to prevail in an experiment, the plasma response can be described as magnetic diffusion or critically damped magnetosonic waves—these being equivalent. Equations for the axial and angular return currents are derived and take the form of decoupled diffusion equations. The effects of pulse shape, boundary conditions, etc. are then treated. The drag force on the beam resulting from the interaction is greatly enhanced and leads to a stopping length reduction by a factor $\frac{1}{2}$(v/sub parallel//c)^3 as compared to non-rotating beams. The implications of these effects for a plasma heating application are discussed.

25580 EQUILIBRIUM THEORY OF TOROIDAL MAGNETIC CUSP CONFINEMENT WITH INTERNAL CIRCULATION. Hammer, J.H.; Kunkel, W.B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Fluids 19: No. 3, 438-442 (Mar 1976).

Plasma confined in the Tormac configuration can be made to rotate about the minor axis so that guiding-center drifts do not carry the particles to the boundary layer even in a purely toroidal field $B(R)$. In this way the anisotropy in velocity space caused by losses at the cusps will not be rapidly communicated to the interior. Rotation can be enhanced and controlled, in principle, by neutral injection with angular momentum about the minor axis. The properties and stability characteristics of such a state are theoretically investigated in the present paper. The conditions for a stationary state are shown to require that the number of particles on a flux tube remains constant, yielding the relation $n(R)\,R/B(R) \simeq$ const. The equilibrium properties of the plasma are observed with the use of two different models: (1) The plasma is treated as consisting of two fluids with negligible centrifugal effects and interspecies interactions, where electrons are considered as isotropic with the equation of state $d/dt\,(P_e n^{-\gamma}) = 0$, while the ions are anisotropic and obey the Chew–Goldberger–Low equations. (2) The plasma is treated as a single fluid with negligible centrifugal effects and scalar pressure, i.e., obeys $d/dt\,(Pn^{-\gamma}) = 0$. In each case the equilibrium solutions $n(R)$ are found to be marginally interchange-stable. (auth)

25581 UNSTABLE PROPAGATION OF A GAUSSIAN LASER BEAM IN A PLASMA WAVEGUIDE. Feit, M.D.; Maiden, D.E. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Appl. Phys. Lett. 28: No. 6, 331-333 (15 Mar 1976).

Laser heating of long magnetically confined plasma columns to fusion temperatures requires propagation of a trapped laser beam over considerable distances. The present paper employs the parabolic approximation to the wave equation to analyze the propagation of a Gaussian beam through a plasma with a parabolic transverse density profile. Although propagation is stable in the axially uniform case, exhibiting alternate focusing and defocusing of the beam, it is unstable to small axial perturbations of certain wavelengths. In particular, an exponentially growing beam radius results from perturbations at wavelengths near that associated with the alternate focusing and defocusing mentioned above. (auth)

25582 RADIO FREQUENCY ION HEATING NEAR THE LOWER HYBRID FREQUENCY. Fidone, I. (Association Euratom-CEA sur la Fusion, Département de Physique de Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, 92260 Fontenay-aux-Roses, France). Phys. Fluids 19: No. 2, 334-335 (Feb 1976).

Wave absorption near the lower hybrid frequency is considered. It is shown that, in a hot plasma, a slow wave approaching the hybrid layer is strongly damped by ion Landau damping. (auth)

25583 RUNAWAY ELECTRONS IN AN IMPURE PLASMA. Cohen, R.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 19: No. 2, 239-244 (Feb 1976).

The electron runaway theories of Kruskal and Bernstein and Lebedev are extended to apply to multiply ionized, multiple species plasmas. The resulting expressions for electron runaway rates are compared with results obtained by Kulsrud, Sun, Winsor, and Fallon from numerical solutions of the Fokker–Planck equation. (auth)

25584 NONLINEAR THEORY OF rf HEATING AT CYCLOTRON HARMONICS. Schmitt, J.P.M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 19: No. 2, 245-255 (Feb 1976).

The nonlinear interaction of a single particle with an electromagnetic wave at a cyclotron harmonic is studied. Emphasis is on the large wavelength limit (fast wave). The cases of a coherent wave particle interaction and of an incoherent interaction are treated. In both cases explicit expressions for the temporal evolution of the particle perpendicular energy distribution function are presented. The heating is efficient at the first two harmonics. The formation of a suprathermic tail is predicted at the second and higher harmonics. (auth)

25585 EXPERIMENTAL OBSERVATION OF ASYMPTOTIC STATE OF TURBULENTLY HEATED ELECTRONS. Hirose, A.; Skarsgard, H.M. (Department of Physics, University of Saskatchewan, Saskatoon, Saskatchewan S7N OWO, Canada). Phys. Rev. Lett. 36: No. 5, 252-254 (2 Feb 1976).

The acceleration and heating rates of plasma electrons observed in a toroidal device have demonstrated the existence of an asymptotic state in which the electrons are isotropically heated with a thermal velocity approximately equal to the drift velocity. (auth)

25586 OBSERVATION OF HIGH-FREQUENCY RADIATION AND ANOMALOUS ION HEATING ON LOW-DENSITY DISCHARGES IN ALCATOR. Oomens, A.A.M.; Ornstein, L.Th.M. (Association EURATOM-Fundamenteel Onderzoek der Materie, Fundamenteel Onderzoek der Materie-Instituut voor Plasmafysica, Rijnhuizen, Jutphaas, The Netherlands); Parker, R.R.; Schüller, F.C.; Taylor, R.J. Phys. Rev. Lett. 36: No. 5, 255-257 (2 Feb 1976).

A radiation spectrum ranging from 300 MHz to 5 GHz is observed in low-density discharges in Alcator. At the lower end this spectrum is strongly peaked at a frequency corresponding to the ion plasma frequency. The emission occurs if the ratio of the drift velocity to the thermal speed of the electrons exceeds 0.45 for discharges in hydrogen or 0.2 in deuterium. The onset of the radiation correlates with the production of energetic ions. (auth)

25587 PLASMA HEATING METHODS. Consoli, T. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). Entropie; 11: No. 61, 41-54(1975). (In French)

The purpose of this information paper is to state the problem of the heating of a plasma, confined in a toroidal configuration, up to temperatures at which the thermonuclear reactor can ignite. In a general and deliberately non-comprehensive survey aimed at a non-specialist reader, the author describes briefly the various methods by which this problem may be solved. A bibliography is included so that any scientist interested in the subject can quickly find the most important references. This survey takes account of similar research conducted throughout the world in laboratories working on controlled fusion. (FR)

25588 SELF CONFINEMENT OF A FLAT-RING PLASMA IN A MAGNETIC FIELD. Marcilhacy, G. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 23, 715-717(16 Jun 1975). (In French)

Solutions of MHD equations for flat-ring plasma configurations with current distribution in the plasma itself are written in a flat-ring cyclide coordinate system. The magnetic field is split up into poloidal and toroidal fields. (FR)

25589 PLASMA LOSS IN THE LEVITATED TOROIDAL OCTUPOLE. Cavallo, A. J. Madison, WI; Univ. of Wisconsin (1975). 211p. University Microfilms Order No. 75-19,058.

Thesis (Ph. D.).

A detailed experimental investigation of plasma loss to the rings and walls of the levitated octupole has been made. The region around the internal rings of the octupole was of special interest, since this region can have absolute magnetohydrodynamic (MHD) stability when the plasma density gradient is directed away from the ring. Loss to the ring can be measured without supports or obstacles near the ring obscuring details of plasma behavior. Loss to the walls of the octupole was measured with 40 cm^2 striped collector patches distributed around the machine, and with collectors mounted on a moveable cart. Loss to the rings was measured by 320 cm^2 striped collector bands wrapped around the minor circumference of a ring. Loss information could be telemetered from the rings via a modulated light beam, with all wires, probes and supports removed from the vicinity of the ring. (Diss. Abstr. Int., B)

25590 MICROWAVE MEASUREMENTS OF ELECTRON DENSITY IN A SPHERICAL INERTIAL-ELECTROSTATIC CONFINEMENT SYSTEM USING SIX ION GUNS. Chan, A. I. Y. Provo, UT; Brigham Young Univ. (1975). 145p. University Microfilms Order No. 76-684.

Thesis (Ph. D.).

The electron density in a spherical inertial-electrostatic confinement device using six ion beams has been studied with microwave techniques involving the fundamental and higher order cavity resonances. Thermal expansion problems were circumvented by switched operation of the device. The deuterium background pressure was found to be a dominant factor in determining n/sub e/ throughout the entire range of 0.4 to 10 milliTorr. With 1 m Torr pressure and 10 mA total ion current (at 20 to 40 keV) central electron densities of the order 10^9 electrons/cm^3 were estimated, with total population of approximately 10^{10} electrons. No evidence of shell structure of the electron density was found, although the use of higher order modes to obtain better spatial resolution was precluded by the low magnitude of n/sub e/. Indirect indication of weak ion trapping was obtained by measurement of the enhancement of neutron flux that resulted when the guns were operated simultaneously. (Diss. Abstr. Int., B)

Plasma Diagnostics

25591 (COO-2711-1) EXTREME ULTRAVIOLET AND SOFT X-RAY DIAGNOSTICS OF HIGH-TEMPERATURE PLASMAS. Annual Progress Report, June 1, 1975–May 31, 1976. Moos, H. W.; Armstrong, L. Jr.; Fastie, W. G. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1976. Contract E(11-1)-2711. 20p. Dep. NTIS $3.50.

The report discusses the four major research areas of this program: diagnostic studies of CTR plasmas, laboratory spectroscopy and calibration at short wavelengths, theoretical computation of transition probabilities for highly ionized atoms, and instrument development for short wavelength studies of CTR devices. Using existing instruments, diagnostic studies are under way at Versator and Elmo Bumpy Torus. A facility has been completed for the sensitivity calibration of spectrometers down to 300 A as complete units. The development of computer programs necessary for transition probability calculations is ninety percent complete. An f/20 forty cm focal length concave grating spectrometer has been constructed utilizing very high vacuum techniques to reduce contamination of plasma devices and calibration sources such as SURF II at NBS. New designs for grazing incidence monochromators have been developed.

25592 (IPF-74-8) SCHLIEREN PLASMA DIAGNOSTICS WITH THE HCN LASER ($\lambda = 337\ \mu$). Kunz, W. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1974. 86p. (In German). INIS.

34 figs.; 18 refs.; with app.

The limits of the application of the schlieren diagnostics method to electron density measurements in the far infrared are outlined. It is calculated that due to a diffraction the uncertainty increases with the root of the wavelength. Two special model schlieren were treated by wave-optical methods. The feasibility of the method of measurement was investigated using a 200 A high-current arc. For the density profile of the Garching Tokamak "Pulsator" diffraction angles of 6 mrad at most were calculated for $\lambda = 337\ \mu$, which are thus at the lower limit of measuring exactness of the schlieren diagnostics in the FIR. (DE)

25593 (IPF-74-12) DEVELOPMENT OF A HYDROGEN FLUORIDE LASER. Pulse Width About 10 ns; for Density Measurements at the Plasma Focus. Schilling, P. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1974. 56p. (In German). INIS.

32 figs.; 26 refs.

A hydrogen fluoride laser with variable pulse width (9 to 25 ns) was developed for measurements of shortlived dense plasmas. This multi-line laser with lambda approximately 2.9 μm operates without an optical pulse cutting system. Peak power of the pulses is about 400 kW. Measurements concerning dependence of FWHA, peak power and energy yield were carried out. Combined with an amplifier of 1 m length, peak power up to 13 MW and energies up to 0.5 J are attained. With this system, time dependence of the power amplification in the amplifier was tested for various gas mixtures. Furthermore, preliminary measurements with time-resolved schlieren interferometry with this system are discussed. A plasma focus device was used as test object. (DE)

25594 (IPF-75-3) SCATTERING DIAGNOSTICS WITH STATIONARY Ar ION LASERS ON FIELD-STABILIZED ARCS. Hirsch, K. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1975. 69p. (In German). INIS.

24 figs.; 55 refs.

The paper describes scattering analyses made on a field-stabilized hydrogen arc below 90° with a continuous Ar ion laser in the W region. The parameters influencing the signal-noise ratio in phase-synchronous diagnostics are discussed, the general dependences are mentioned, and the exactness of measurement to be expected for the plasma and geometry chosen is given as a factor of the laser power and the period of measurement. Specific features of the scattering profiles under observation are related to the initiation of plasma oscillations by the laser. These assumptions are collaborated by control measurements (HF Stark effect on forbidden He lines). (GE)

25595 PLASMA DIAGNOSTICS USING LASER-EXCITED COUPLED AND TRANSMISSION RING RESONATORS. Haas, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Appl. Phys. 47: No. 3, 879-885 (Mar 1976).

In this paper a simple two-level laser model is used to investigate the frequency response of coupled-cavity laser interferometers. It is found that under certain circumstances, often satisfied by molecular gas lasers, the frequency response exhibits a resonant behavior. This behavior severely complicates the interpretation of coupled-cavity laser interferometer measurements of rapidly varying plasmas. To circumvent this limitation a new type of laser interferometer plasma diagnostic with significantly improved time response was developed. In this interferometer the plasma is located in one arm of a transmission ring resonator cavity that is excited by an externally positioned laser. Thus, the laser is decoupled from the interferometer cavity and the time response of the interferometer is then limited by the Q of the ring resonator cavity. This improved time response is acquired without loss of spatial resolution, but requires a more sensitive signal detector since the laser is no longer used as a detector as it is in conventional coupled-cavity laser interferometers. Thus, the new technique incorporates the speed of the Mach–Zender interferometer and the sensitivity of the coupled-cavity laser interferometer. The basic operating principles of this type of interferometer have been verified using a CO_2 laser. (auth)

25596 CHARACTERISTICS OF A LARGE-VOLUME rf–GRID DISCHARGE PLASMA. Schumacher, R.W.; Hershkowitz, N.; MacKenzie, K.R. (Department of Physics, University of California, Los Angeles, California 90024). J. Appl. Phys. 47: No. 3, 886-893 (Mar 1976).

The properties of a large-volume rf (75 MHz) -grid discharge plasma have been determined. Measurements in the steady state and in the afterglow indicate that the rf grid produces a plasma with two electron components—a secondary Maxwellian component of density 2×10^{10} electrons/cm^3 and temperature 4.5 eV and a "primary" component of density 1×10^{10} electrons/cm^3 and temperature approximately 15 eV. The ion temperature is $\simeq$0.3 eV. A useful 35-liter argon plasma with a noise level on the order of 1% is easily produced in neutral pressure backgrounds as low as 4×10^{-5} Torr. (auth)

25597 USE OF UF-R AND UF-VR PHOTOGRAPHIC PLATES IN LASER PLASMA DIAGNOSTICS BASED ON CONTINUOUS X-RAY RADIATION IN 0.1-1 nm SPECTRAL RANGE. Kologrivov, A.A.; Mikhailov, Yu.A.; Sklizkov, G.V.; Fedotov, S.I.; Shikanov, A.S.; Shpol'skii, M.R. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 10, 1210-1214 (Oct 1975).

The results are given of an experimental investigation of a possible use of UF-R and UF-VR photographic films for diagnostics of a high-temperature plasma formed as a result of focusing of 1.06 μ laser radiation on the surface of a flat bulk Al target. These films were used to record continuous x-ray radiation in the 0.1–1 nm range. An analysis

was made of the method of multichannel detection of x-ray radiation by photographic films. The method was applied to the measurement of the electron temperature of a plasma generated by laser radiation of 10^{13}–10^{15} W/cm^2 power density. The absolute and relative sensitivities of the UF-R and UF-VR photographic films to x-ray radiation were determined experimentally. (auth)

25598 EFFECT OF BOUNDARY-LAYER ELECTRON-ION RECOMBINATION ON AN ELECTROSTATIC PROBE. Chekalin, E.K.; Novgorodov, M.A.; Khandurov, N.V. (G. M. Krzhizhanovskii State Scientific Research Energetics Institute, Moscow). Sov. Phys.—Tech. Phys. 20: No. 7, 888-891 (July 1975).

Experimental and calculated data are compared on the determination of the electron density in a supersonic plasma flow by means of an electrostatic wall probe for laminar and turbulent boundary layers. It is assumed that there is no electron-ion recombination in the volume. Experiments are carried out in a shock tube with a supersonic flow of an argon plasma over the electron-density range from 10^{16} to 10^{14} cm^{-3}. Wall probes can give reliable measurements only if the rate of electron-ion recombination is negligible in comparison with the rate of diffusive transport of charged particles. (auth)

25599 TECHNICAL AND EXPERIMENTAL INVESTIGATIONS OF A PLASMA FOCUS NEUTRON SOURCE. Rapp, H. K. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). pp 372-377 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps.). Paris, France; Association Nationale de la Recherche Technique ([nd]). (In German)

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

The results obtained from two plasma-focus devices of different size allow reporting on the technical and physical properties of such neutron flash sources. The results of some diagnostic methods used for the control of the gas discharge and for the measurement of the neutron production are included. The planning of plasma focus devices is illustrated with the aid of snow-plow calculations. (FR)

25600 HIGH-SPEED INTERFEROMETRY OF EXPANDING AND COLLAPSING LASER PRODUCED PLASMA. Basov, N. G.; Boiko, V. A.; Gribkov, V. A.; Zakharov, S. M.; Krokhin, O. N.; Nikulin, V. Ya.; Sklizkov, G. V. (AN SSSR, Moscow. Fizicheskij Inst.). pp 248-251 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps.). Paris, France; Association Nationale de la Recherche Technique ([nd]).

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

An installation with a good time and space resolution for the interferometric investigation of dense non-stationary plasma is described. The installation consists of a Mach-Zender interferometer, an electro-optical image converter camera and a ruby laser with an impulse of variable duration of 1nsec to 150nsecs. (FR)

25601 LASER INTERACTION WITH MATTER AS A SOURCE OF U.V. AND SOFT X-RAY RADIATION: APPLICATION TO X-RAY CINEMATOGRAPHY. Tonon, G. F.; Colombant, D.; Delmare, C.; Rabeau, M. (CEA Centre d'Etudes de Limeil, 94-Villeneuve-Saint-Georges (France)). pp 108-113 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps.). Paris, France; Association Nationale de la Recherche Technique ([nd]). (In French)

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

A new detecting device is described. It allows one to get the frequency, the time and space resolution of pictures of U.V. and soft x ray emission of a laser created plasma in a single shot: x ray pictures of such a plasma are presented. After these preliminary results, it is possible to set up readily an x ray framing camera. A laser created plasma is an x ray source of special interest: the emitted power can be 10% of the laser intensity and the emitted spectrum is centered around 1A wavelength. (FR)

25602 APPLICATION OF IMAGE-CONVERTER TECHNIQUE IN QUANTUM RADIOPHYSICS AND NONLINEAR OPTICS (SURVEY PAPER). Korobkin, V. V.; Malyutin, A. A.; Prokhorov, A. M.; Serov, R. V.; Schelev, M. Ya. (AN SSSR, Moscow. Fizicheskij Inst.). pp 84-91 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps.). Paris, France; Association Nationale de la Recherche Technique ([nd]).

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

Some requirements which high-speed image-converter cameras intended for laser research should meet are analyzed. Different modifications of the developed cameras are described and some methodological aspects of their application are discussed. These cameras were applied for lasers, laser plasma and self-focusing studies. The experimental results obtained are also presented. (FR)

25603 THE APPLICATION OF HIGH-SPEED PHOTOGRAPHY AND SPECTROGRAPHY FOR INVESTIGATIONS OF EROSIVE PULSED PLASMA STREAMS. Kiselevskiy, L. I.; Minko, L. Ja. (AN Belorusskoj SSR, Minsk. Inst. Fiziki). pp 521-524 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps.). Paris, France; Association Nationale de la Recherche Technique ([nd]).

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

The extensive information of pulsed plasma dynamic processes related to formation and interaction of plasma streams with a surrounding medium and obstacles is obtained with the help of high-speed photo and spectrography. The wave structure of pulsed supersonic under-expanded erosive plasma jets is studied. Some physical processes which are due to interactions of laser radiation with the laser-produced erosive plasma and of this plasma with a surrounding medium are investigated. The wide possibilities of frame photography of spectra quantitative spectroscopic investigations of fast-proceeding plasma processes are shown on the basis of joint use of high-speed photographic apparatus (type SFR) and standard spectrographs. The radial distribution of charged-particle concentrations at separate moments of time is obtained from the broadening of spectral lines at the brightness of the continuous spectrum of an erosive plasma jet from a pulsed accelerator. (FR)

25604 SCHLIEREN TECHNIQUES AND INTERFEROMETRIC METHODS USING TEA-CO_2 LASERS FOR THE INVESTIGATION OF TRANSIENT PHENOMENA BY MEANS OF THERMAL LIQUID CRYSTAL IMAGE CONVERTERS. Hugenschmidt, M.; Vollrath, K. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). pp 515-520 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps). Paris, France; Association Nationale de la Recherche Technique ([nd]). (In German)

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

In order to investigate plasmas with electron densities in the 10^{15} to 10^{18} cm^{-3} range, schlieren techniques and interferometric methods are used with a TEA-CO_2 laser. The thermo-optical conversion is achieved by means of cholesteric liquid crystal layers. The possible uses of this technique are examined in view of recording dynamic transient phenomena, attention being paid to response time, resolving power, and quantitative information obtained. Examples are given for records taken from the formation and expansion of electric spark discharges. The experimental results are in good agreement with the computed numerical data. (FR)

25605 MEASUREMENT METHODS FOR THE STUDY OF TOKAMAK TFR PLASMA. Etievant, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section de Physique des Plasmas). Entropie; 11: No. 61, 55-69(1975). (In French).

This paper reviews the diagnostics in operation or still under development in order to study the main parameters of the plasma of TFR (electron and ion temperature, current density), the electrical behavior of the discharge, the densities of neutral gas and of impurities and the parameters of plasma turbulence. (FR)

Plasma Kinetics (General)

25606 (CONF-750905-24) HEATING AND IONIZATION IN MHD SHOCK WAVES PROPAGATING INTO PARTIALLY IONIZED PLASMA. Bighel, L.; Collins, A. R.; Cramer, N. F.; Watson-Munro, C. N. (Sydney Univ. (Australia). School of Physics). Sep 1975. 7p. Dep. NTIS (US Sales Only) $3.50.

From 7th European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

A model of the structure of MHD switch-on shocks propagating in a partially ionized plasma, in which the primary dissipation mechanism is friction between ions and neutrals, is here compared favorably with experimental results. Four degrees of upstream ionization were studied, ranging from almost complete to very small ionization.

25607 (IPF-74-9) EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE EXTRA-THERMAL CONDUCTIVITY OF A SUPERSONIC FLOW DURING CURRENT FLOW. Frey, H. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1974. 108p. (In German). INIS.

54 refs.; with figs.

This is an investigation into increased electrical conductivity in a supersonic plasma flow with the aid of super-thermal ionization. The rare gas plasma is produced in a gas-dynamical membrane shock wave tube. Measured were the flow variables as well as the state variables. On the basis of a multi-component theory a simplified plasma flow model was used to evaluate its non-equilibrium behavior. Experimental and theoretical conclusions resulted in mathematical interrelationships 1) for decelerating supersonic flow due to Ohmic heating of the electron components and energy transfer by means of elastic collisions on heavy particles, 2) concerning the decreasing rise in the temperature of electrons at increasing pressure, and 3) for the interdependence between electrical conductivity and electron density. (DE)

25608 (IPF-74-11) SPACE- AND TIME-RESOLVED MEASUREMENTS OF THE X-RAY EMISSION NEAR THE PLASMA FOCUS. Nahrath, B. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1974. 107p. (In German). INIS.

The paper describes methods for studies of the energy of an X-ray source and carries out a time-resolved localization of the focus plasma in the soft X-ray region using a pulsed channeltron plate. Instantaneous photographs made in the visible light and in the spectral region of soft X-ray emission are compared. Temperature measurements with various pairs of foils lead to the conclusion that the X-ray emission is not caused by a pure bremsstrahlung spectra.

25609 (LBL-3399(Suppl.), pp I.4.1-I.4.6) BEHAVIOR OF PLASMA BOUNDARY NEAR AN APERTURE OF ION SOURCE. Yamagishi, T.; Akimune, H. (Osaka Univ.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Behavior of the ion sheath near an aperture of ion source is investigated via a nonlinear Poisson equation for an electric potential function in a cylindrical coordinate system. On the assumptions of free electrons with Maxwellian distribution and ion flow against the aperture, the sheath condition and the condition under which the plasma surface is concave are derived. These conditions are shown to depend on the aperture radius, potential of electrode U, electron temperature kT/sub e/ and initial ion velocity. The ion current through the aperture with maximum radius is found to increase significantly when U is greater than or equal to 20kT/sub e/. Behavior of the potential distribution and plasma boundary under various situations are also demonstrated by means of numerical calculations. (auth)

25610 (LBL-3399(Suppl.), pp I.5.1-I.5.5) LARGE-AREA PLASMA SOURCES. Ehlers, K. W.; Baker, W. R.; Berkner, K. H.; Cooper, W. S.; Kunkel, W. B.; Pyle, R. V.; Stearns, J. W. (Univ. of California, Berkeley). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

High-current ion sources for neutral-beam injection into controlled-fusion experiments require large-area uniform high-density plasmas from which to extract the ions. Three types of such sources have been constructed for use with several injection experiments. All generate the plasma by a diffuse low-pressure high-current discharge from distributed thermionically emitting cathodes, without the use of externally applied magnetic fields. Two are short pulse (t equals 30 and 10 msec, power, supply limited) sources from which deuterium ion-current densities of approximately 0.5 A/cm^2 are extracted from a 7- x 7-cm square array and from a 7- x 35-cm rectangular array. The third operates for 10 sec and gives a hydrogen ion-current density of 0.25 A/cm^2 over a 10-cm diameter. The design differences for long- and short-pulse operation, as well as the operating characteristics of each, will be discussed. (auth)

25611 (LBL-3399(Suppl.), pp I.7.1-I.7.4) DESIGN OF A GENERAL PURPOSE DUOPLASMATRON. Aberth, W.; Schnitzer, R.; Engesser, F.; Anbar, M. (Stanford Research Inst., Menlo Park, CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A duoplasmatron ion source, capable of rapid conversion between negative and positive beam operation has been constructed. Both filament and hollow cathode arc sources are used. In addition, the source can be operated in the hollow-discharge mode, and off-axis negative ion extraction techniques can be utilized. High purity ion beams are obtained by the use of metal gasket vacuum scales in the source, careful attention to cleanliness in the gas inlet system, and the use of special techniques such as hot CuO to oxidize hydrocarbons in the sample gas. (auth)

25612 (LBL-3399(Suppl.), pp I.8.1-I.8.6) CHARGE MODES OF PULSED HIGH ENERGY AND HIGH DENSITY PLASMA INJECTION SOURCE. Cheng, D. Y. (Univ. of Santa Clara, CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Detonation (snowplow), deflagration and other modes of discharge can be produced in a single coaxial plasma gun. Conservation laws of mass, momentum and energy together with the entropy production condition of the discharge phenomena are used to identify dense discharge modes. The Rankine-Hugoniot relation for a magnetized plasma is derived. Discussions of how to design a deflagration plasma gun to yield a prescribed plasma kinetic energy and plasma beam density are given. (auth)

25613 (LBL-3399(Suppl.), pp II.1.1-II.1.10) COMPUTER-AIDED EXTRACTOR DESIGN. Cooper, W. S.; Halbach, K.; Mag Magyary, S. B. (Univ. of California, Berkeley, CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A computer program, WOLF is described that simulates ion extraction from a plasma and acceleration through an electrode structure and optimizes the performance of the extractor (minimizes the final beam divergence) by varying the potentials, shapes, and positions of the electrodes. WOLF also finds the self-consistent shape and position of the plasma equipotential representing the emitter. The measured performance of the slot extractors agrees well with the computed performance based on our model for the plasma if the ions are assumed to have a temperature of about 1 eV at the emitter. The most important factors affecting the beam divergence are, in decreasing order of importance, (1) gross electrostatic lens effects, including the space-charge of the ions, (2) the initial ion temperature, (3) the shape of the first, or "beam-forming," electrode, and (4) the shape and position of the plasma sheath edge, or emitter. (auth)

25614 (LBL-3399(Suppl.), pp II.2.1-II.2.4) COMPUTER SIMULATION OF FOCUSED ION BEAMS. Boers, J. E.; Freeman, J. R.; Poukey, J. W. (Sandia Labs., Albuquerque, NM). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Two digital computer programs have been employed in the simulation of plasma expansion cups and the ion beams drawn from them. The axially symmetric ion beam is simulated with a relativistic beam program assuming that a particular plasma surface exists on the plasma expansion cup. Electrodes are employed which produce a focused ion beam at the voltage and current desired assuming space-charge-limited emission from the plasma surface. Then, boundary conditions are taken from the beam simulation near the plasma surface and used as input data for the plasma simulation program. The shape of the cup and the plasma injection rate can then be varied until the proper ion current is obtained from a surface close to that assumed in the beam program. Using this technique, deuteron beams of more than one ampere of current and source current densities in excess of 10^4 amperes per meter^2 have been simulated. (auth)

25615 (LBL-3399(Suppl.), pp II.3.1-II.3.5) FURTHER MEASUREMENTS OF THE ION OPTICS OF A SINGLE APERTURE THREE ELECTRODE EXTRACTION SYSTEM. Thompson, E. (UKAEA, Oxfordshire, Eng.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and

formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The results are reported of a detailed study of the ion optical performance of the disk aperture extraction system with particular regard to establishing the differences between the performance of the simple aperture studied by Coupland et al. and that of an approximation to a design based on Pierce geometry. Measurements of beam perveance emittance and divergence from the two systems are presented. Some of the implications of this work are discussed with regard to high current multiaperture ion sources being developed for fusion research. (auth)

25616 (UCRL-13669) STARK BROADENING IN HOT, DENSE LASER-PRODUCED PLASMAS. Tighe, R. J.; Hooper, C. F. Jr. (Florida Univ., Gainesville (USA)). 1976. 36p. Dep. NTIS $4.00.

Broadened Lyman-alpha x-ray lines from neon X and argon XVIII radiators, which are immersed in a hot, dense deuterium or deuterium-tritium plasma, are discussed. In particular, these lines are analyzed for several temperature-density cases, characteristic of laser-produced plasmas; special attention paid to the relative importance of ion, electron, and Doppler effects. Static ion microfield distribution functions are tabulated.

25617 POPULATION-INVERTED MEDIUM FOR STIMULATED EMISSION IN VACUUM ULTRAVIOLET. Vinogradov, A.V.; Skobelev, I.Yu.; Sobel'man, I.I.; Yukov, E.A. (P.N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 10, 1192-1195 (Oct 1975).

The populations of excited states of multiply charged He-like ions are calculated for a high-temperature plasma. It is shown that, if the optical thickness of the plasma τ_ν, measured at the center of a resonance line, is not too great ($\tau_\nu \lesssim 30$), a population inversion is established between a series of triplet and singlet levels. If the ionic charge is $Z \sim 10$, inverted transitions give rise to radiation of wavelengths $\lambda \sim 5$–15 nm. The dependences of the population inversion and gain on the plasma density and temperature are derived. Consideration is given to the possibility of generation of coherent radiation as a result of stimulated anti-Stokes scattering of visible laser radiation in plasma systems of this kind. (auth)

25618 CONTROL OF THE ELECTRON TEMPERATURE IN A LOW-DENSITY PLASMA STREAM. Netsvetailov, E.M.; Skvortsov, V.V. Sov. Phys.—Tech. Phys. 20: No. 7, 990-991 (July 1975).

A method is discussed for controlling the electron temperature in a plasma stream produced by a gas-discharge ion source; the positive space charge is neutralized by electrons from a filament. (auth)

25619 POPULATION INVERSIONS WITH RESPECT TO THE GROUND LEVEL OF AN ION OR ATOM BY THE RAPID COOLING OF A PLASMA. Green, J.M.; Silfvast, W.T. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Appl. Phys. Lett. 28: No. 5, 253-255 (1 Mar 1976).

General conditions are derived for achieving an inversion with respect to the ground level of an atom or ion by rapid cooling of a plasma. As an example, gain on the He^+ 304-Å resonance transition in a laser-produced helium plasma is considered in detail. (auth)

25620 ELECTRON TEMPERATURE DETERMINATION FROM NON-LTE POPULATIONS IN A NITROGEN PLASMA JET. Catherinot, A.; Sy, A. (Orleans Univ., 45 (France). Lab de Physique des Milieux Ionises). Z. Naturforsch., A; 30: No. 9, 1143-1163(Sep 1975).

10 figs.; 3 tabs.; 39 refs.

Atomic nitrogen electronic state populations and electron density have been measured in a high power nitrogen plasma jet in the pressure range 50 < P (Torr) < 150. A Boltzmann plot of the excited state populations led to electronic excitation temperatures depending on the groups of levels considered. Low and high lying levels yielded excitation temperatures which differed up to 80% at P = 120 Torr. The measured data are analyzed in the frame of a two-temperatures diffusion-dominated plasma model. (DE)

25621 PRINCIPLES OF CONTROLLED THERMONUCLEAR FUSION. Samain, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Entropie; 11: No. 61, 5-9(1975). (In French)

The achievement of nuclear fusion for industrial energy production is only possible if the reacting nuclei have a thermonuclear temperature at least equal to 10^8 deg K. The experimental work follows mainly two lines: the first one consists of irradiating a small dense pellet by giant laser pulses so that nuclear reactions take place significantly before the matter is dispersed. Another possibility relies upon the concept of magnetic trap where the thermonuclear temperature could be maintained by the energy released by the nuclear reactions. (FR)

Plasma Kinetics (Experimental)

25622 MEGA-GAUSS TURBULENCE DUE TO SEEDED COMPOSITION FLUCTUATIONS IN DENSE PLASMA, AND ELECTRON BEAM SCATTERING. Tidman, D.A. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). Phys. Fluids 19: No. 2, 321-326 (Feb 1976).

Fine scale variations in the chemical composition of a collision-dominated plasma give rise to corresponding spatial fluctuations in the electron density, which persist until being dispersed by diffusive or turbulent mixing. In the presence of a steep background temperature gradient these density fluctuations are expected to give rise to magnetic field fluctuations that reach the mega-Gauss range for temperatures of about a kilovolt. Using a simplified static plasma model, a spectrum is derived for the field fluctuations, together with a diffusion operator for the enhanced scattering of energetic particles in such a plasma. This phenomenon may be of interest in the design of targets for electron-beam driven fusion. (auth)

25623 NONLINEAR SKIN EFFECT OF HIGH-POWER MICROWAVES AND A DENSITY-RAREFACTION WAVE IN A COLLISIONLESS MAGNETOPLASMA. Minami, K.; Mori, Y.; Takeda, S. (Department of Electrical Engineering, Nagoya University, Nagoya, 464, Japan); Ishii, K. Phys. Fluids 19: No. 2, 327-333 (Feb 1976).

Experimental results are presented which verify the nonlinear skin effect of high-power microwaves incident on a collisionless, uniform plasma having a sharp boundary. The skin depth, observed by microwave reflection techniques, increases with the incident microwave power. The results are compared with the theoretical analysis in which the radiation pressure due to the electromagnetic field is taken into account. It is also found that a density-rarefaction wave caused by an incident microwave propagates through an over-dense plasma at a velocity closer to that of the ion acoustic wave. (auth)

25624 SEPARATION OF IONS WITH LARGE MASS DIFFERENCES IN A PLASMA. Berezov, D.V.; Demidenko, I.I.; Lomino, N.S.; Morozov, A.I.; Padalka, V.G. (Physical Technical Institute, Academy of Sciences of the USSR, Khar'kov). Sov. Phys.—Tech. Phys. 20: No. 7, 906-908 (July 1975).

The possibility of using transverse magnetic fields for mass separation of ions in a plasma is examined. It is shown that this method gives effective ion separation directly from the plasma phase when the ion components have different masses. (auth)

25625 ELECTRICAL CONDUCTIVITY OF A FULLY IONIZED PLASMA IN AN EXTERNAL MAGNETIC FIELD. Vaucher, B. G.; Vaclavik, J.; Schneider, H. (Univ., Freiburg, Ger.). Helv. Phys. Acta; 48: 699-719(1975). (In German).

The electrical conductivity of a homogeneous fully ionized argon plasma in a homogeneous magnetic field was investigated by means of magnetoacoustic resonance. In particular, the conductivity perpendicular to the magnetic field $\sigma_\perp$ was determined for different values of the parameter ω_c/ν_{ei}, where ω_c is the electron cyclotron frequency and ν_{ei} is the collision frequency between electrons and ions. The results appear to be in good agreement with the tranport theory of Braginskii. In plasmas with small ω_c/ν_{ei}, the ratio of $\sigma_\perp$ to the conductivity along the magnetic field approximately equals 1 while with increasing ω_c/ν_{ei} it drops to $1/2$. (auth)

25626 INVESTIGATIONS OF XUV AND SOFT X-RAY EMISSION FROM PLASMAS PRODUCED BY PICOSECOND PULSES FROM SOLID TARGETS. Dewhurst, R. J.; Khan, M. A.; Pert, G. J. (Hull Univ., Eng.). J. Phys., B (London); 8: No. 13, 2301-2310(11 Sep 1975).

Emission spectra in the range 10 to 250 Å from plasmas produced by picosecond laser pulses from a variety of solid targets are presented. These spectra provide some useful information about the state of ionization of the plasma and other plasma parameters such as temperature. Some of the results obtained are compared with the predictions of detailed numerical calculations. Ionization in these plasmas proceeds rapidly before reaching a limit. Depending on the laser energy input this limit generally occurs at a closed shell where further ionization is inhibited by the large jumps in the binding energy of the closed-shell electrons. (auth)

25627 PLASMA BEHAVIOR IN A ROTATING MAGNETIC FIELD. Shubaly, M. R. Saskatchewan, Canada; Regina Univ. (1974). 144p. University Microfilms Order No. 76-742.

Thesis (Ph. D.).

A system was constructed and used to study the behavior of a plasma in a rotating magnetic field in a toroidal system. The plasma with density less than or equal to 10^{18} m^{-3}, electron tem-

perature approximately 10^5 °K is first formed by rf pre-ionization at low pressure (0.8 m Torr), in the presence of a quasi-steady toroidal magnetic field of 0.4 T. The 1.85 MHz rotating magnetic field is generated by two perpendicular four-turn coils driven in phase quadrature by an amplifier and a variable coupler. Maximum rotating field strength in the presence of a plasma is 1.3 mT. Plasma electron density and temperature are measured with Langmuir probes. Pickup loops are used to determine plasma currents by measuring the magnetic field that they generate. (Diss. Abstr. Int., B)

Plasma Kinetics (Theoretical)

Refer also to abstracts 25640 and 27588.

25628 EFFECT OF MIRRORING ON CONVECTIVE TRANSPORT IN PLASMAS. Kamimura, T.; Dawson, J.M. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 36: No. 6, 313-316 (9 Feb 1976).

The effect of magnetic mirroring on convective transport in a thermal plasma with ergodic lines is investigated by computer simulation. It is found that mirroring significantly enhances convective transport and estimates show that this effect can be important for existing fusion devices. (auth)

25629 VLASOV CONFINEMENT EQUILIBRIA IN ONE DIMENSION. Hewett, D.W.; Nielson, C.W.; Winske, D. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico). Phys. Fluids 19: No. 3, 443-449 (Mar 1976).

A method for constructing one-dimensional Vlasov equilibria from assumed macroscopic moments is described and examples are given. General properties of these equilibria, in particular, the fact that temperature anisotropy in the two directions perpendicular to the magnetic field is required, are discussed. Results of particle simulations which verify the validity of these equilibria and illustrate the effects of temperature anisotropy are presented. (auth)

25630 LINEAR RESPONSE THEORY OF A TURBULENT PLASMA. Nambu, M. (College of General Education, Kyushu University, Ropponmatsu, Fukuoka, 810, Japan). Phys. Fluids 19: No. 3, 412-419 (Mar 1976).

The linear response theory of a turbulent plasma is presented. The procedure of obtaining the dielectric constant of a turbulent plasma is presented using quasi-linear techniques. The principal result of the theory is the electron orbit modification due to the steady Langmuir turbulence fields. The collisional dissipative parametric destabilizing effect of the Langmuir turbulence fields on the ion sound waves appears. A steady turbulent state is maintained by the competing processes between the linear Landau damping effect and the collisional dissipative parametric destabilizing effect of the Langmuir turbulences. It is suggested that the generalized parametric resonance effect is effective for ion heating through linear Landau resonance. The critical Langmuir wave fluctuation level is given in terms of the ion-to-electron temperature ratio and wavelength. The steady plasma turbulence theory is applicable to plasma far from the thermal equilibrium state. (auth)

25631 SOME DIFFUSION EQUATIONS IN PLASMA PHYSICS. Peyraud, J.; Coste, J. (Laboratoire de Physique de la Matière Condensée, Parc Valrose, 06100 Nice, France). Phys. Fluids 19: No. 3, 388-393 (Mar 1976).

Unstable diffusion equations of the form $[\partial_t - \partial_x D(x)\,\partial_x]\, f(x,t) = \gamma(x)\, f(x,t)$ are studied. In the absence of the dissipation function $\gamma(x)$, the Green's function of the equation when $D \simeq x^{-n}$ (n is an even integer) is derived. Considering the propagation of unstable modes, the over-all growth rate of the distribution of the modes, when $\gamma(x)$ is a sharply peaked function, is evaluated. The three-dimensional propagation of unstable modes for the case $D = C^n$ are also considered. It is shown that the diffusion may suppress the instability of the modes. (auth)

25632 TWO-SPECIES FLOW IN RELATIVISTIC DIODES NEAR THE CRITICAL FIELD FOR MAGNETIC INSULATION. Bergeron, K.D. (Plasma Theory Division-5241, Sandia Laboratories, Albuquerque, New Mexico 87115). Appl. Phys. Lett. 28: No. 6, 306-308 (15 Mar 1976).

An analysis of space-charge-limited counterstreaming flow of ions and electrons in a high-voltage planar diode in the presence of a strong transverse magnetic field is presented. A two-component one-dimensional cold-fluid model is used which includes most self-consistent effects. A substantial enhancement of ion current by a factor of 3–6 is found at fields slightly larger than the critical magnetic insulation field. (auth)

25633 STABILITY OF NONLINEAR PARAMETRIC-DECAY INTERACTIONS IN FINITE HOMOGENEOUS PLASMA. Fuchs, V.; Beaudry, G. (Direction Sciences de Base, Institut de Recherche de l'Hydro-Québec, Varennes, Québec, Canada). J. Math. Phys. (N.Y.) 17: No. 2, 208-213 (Feb 1976).

We prove the existence and uniqueness of a stable steady state of stimulated backscattering from a bounded homogeneous lossless interaction region, with boundary conditions corresponding to a steady incident pump wave-mode Poynting flux and zero-flux input to the decay wave modes. In steady state, once the excitation of the interaction region exceeds a certain critical value, the boundary value problem is characterized by a finite number of eigenvalues, and associated nontrivial eigenfunctions equilibria of the system, corresponding to mutually distinct states of anomalous reflection of the pump wave. A stability analysis of these equilibria with respect to small phase and amplitude perturbations reveals that (i) in the vicinity of the nonfundamental equilibria the phase perturbations exhibit singularities, preventing phase locking from occurring, and (ii) in the vicinity of the fundamental equilibrium both the phase and amplitude perturbations asymptotically vanish. A WKBJ phase-integral stability condition is derived to show that growing normal modes of the amplitude-perturbation boundary-value problem cannot propagate in the potential formed by the field of the depleted, spatially inhomogeneous, pump of the fundamental equilibrium. (auth)

25634 MOBILITY AND DIFFUSION OF IONS IN GASES. McDaniel, E. W.; Mason, E. A. Wiley Series in Plasma Physics. New York; John Wiley and Sons, Inc. (1973). 381p.

The following chapters are included: (1) measurement of drift velocities and longitudinal diffusion coefficients, (2) measurement of transverse diffusion coefficients, (3) afterglow techniques, (4) kinetic theory of diffusion and mobility, (5) interaction potentials and mobility, and (6) experimental data on mobilities and diffusion coefficients. (MOW)

25635 PLASMA FREQUENCY OF THE ELECTRON GAS IN LAYERED STRUCTURES. Apostol, M. (Institutul de Fizica Atomica, Bucharest (Romania)). Z. Phys., B; 22: No. 1, 13-19 (1975).

6 refs.

The plasma frequency of a degenerate electron gas in the layer model of Visscher and Falicov is calculated by means of both the Bohm-Pines canonical transformation method and the equation-of-motion method in the RPA. The dispersion equation for plasmons is obtained in a finite system of n planes with both the cyclic condition and free ends. It is shown that the thermodynamic limit (n → infinite) of the plasma frequency is independent of the boundary conditions. The previous results obtained by various authors in different ways are shown to be certain limits of our result. (DE)

25636 EQUATIONS CINETIQUES DES FLUIDES ET DES PLASMAS. (Kinetic equation of fluids and plasmas). Babuel-Peyrissac, J. P. Paris; Gordon and Breach (1974). 299p. (In French).

Also published in English.

The following problems are treated in this manual: particle shock theory, study of the state of a system, thermodynamic equilibrium, kinetic equations, hydrodynamics, classical plasma theory. (FR)

25637 EXCITATION OF SURFACE ELECTROMAGNETIC WAVES BY A RELATIVISTIC ELECTRON BEAM IN A DISSIPATIVE PLASMA. Grigor'ev, V. P.; Shulaev, N. S. (Tomsk Order of Labor Red Banner Polytechnic Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1590-1593(1975). (In Russian).

The interaction between a relativistic electron beam and a dense magnetoactive confined dissipative plasma is considered. The spectrum of electromagnetic surface waves excited by the beam is defined with taking into account collisions of electron plasma with heavy particles. The increments of oscillations are investigated as a function of the parameters of beam, plasma and intensity of the external magnetic field. (auth)

Plasma Production

Refer also to abstracts 26944 and 27194.

25638 (EUR-CEA-FC-776) HOT ELECTRON TARGET PLASMAS. Part 2: Numerical Simulation. Bardet, R.; Briand, P.; Dupas, L.; Gormezano, C.; Melin, G.; Werkoff, F. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1975. 36p. (In French). INIS.

In the case of neutral injection on a hot electron target plasma, the use of the existing Fokker-Planck codes is greatly complicated by the fact that the scale of the energies of the confined ions and electrons is very large. To avoid this difficulty, a simplified

multispecies model is used in which the particle losses are described by a differential system. During the neutral injection instantaneous high values of the ambipolar potential (higher than the half value of hot ion energy) may appear, but do not prevent hot ion density build-up. However the hot electron target plasma must not be maintained for a too long time. Numerical runs are performed with typical target parameters: density $2.10^{13}cm^{-3}$, electron energy 30 keV, ion energy 400 eV, time duration when the target density is maintained 1 ms. Hot ion density, a few $10^{14}cm^{-3}$, can be achieved with neutral beam of 100 A, 20 keV. (FR)

25639 (LBL-3399(Suppl.), pp I,2,1-I,2,14) CHARACTERISTICS OF REFLEX DISCHARGE ION SOURCES. Green, T. S. (UKAEA Association for Fusion Research, Oxon, Eng.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Investigations of the underlying principles of two types of reflex discharge ion sources are being carried out in this laboratory. The sources are the P. I. G. discharge source with self heated cathodes in a uniform magnetic field, used for production of multiply charged ions, and the directly heated cathode, reflex arc with an axisymmetric divergent magnetic field, for the production of light ions. A review is given of the investigations of these sources, showing how they developed from previously published studies of ion sources, with particular emphasis on a comparison drawn between their operating conditions and the role of energetic and thermal electrons in ionizing the neutral gas. Discussion is limited to the problem of the steady state equilibrium, and problems of stability are not considered. (auth)

25640 ELEMENTARY VIEW OF FUSION IMPLOSIONS. Osborn, R.K. (Department of Nuclear Engineering, University of Michigan, Ann Arbor, Michigan 48104); Mayer, F.J. Am. J. Phys. 44: No. 2, 149-152 (Feb 1976).

The implications of some elementary solutions of the hydrodynamic equations for simple fluids are explored for scaling relations for—and insight into—the dynamics of imploded fusion targets. Because the model is so simple, analytical solutions are available and explicit formulas for such quantities as neutron yield, bremsstrahlung spectra and yield, etc., can be deduced. Where possible, comparison is made with the results of laser-fusion experiments being performed in the KMS Fusion laboratories. (auth)

25641 PRODUCTION AND ABUNDANCE MEASUREMENTS OF HIGHLY STRIPPED ARGON IONS IN ECR HEATED PLASMAS. Briand, P.; Geller, R.; Jacquot, B.; Jacquot, C.; Theiss, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Grenoble, 38 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 23, 711-714(16 Jun 1975). (In French).

A machine is described which creates highly stripped argon ions by heating a plasma at ECR. The main plasma parameters are described and the relative abundances of ion currents extracted from the plasma are analyzed. (FR)

25642 CROSS-SECTION SENSITIVITY OF THE D-T FUSION PROBABILITY AND THE D-T AND T-T REACTION RATES. Santoro, R. T.; Barish, J. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 59: No. 2, 189-194(Feb 1976).

The cross-section sensitivity of the fusion probability has been calculated for various conditions of incident deuteron energy and plasma electron temperature. The fusion probability is most sensitive to the D-T cross section at the higher energies (greater than or equal to 50 keV), and, based on the reported errors in the cross section, the errors in the calculated fusion probabilities should be less than or equal to 10 percent. The cross-section sensitivities of the D-T reaction rate in a D-T plasma and the T-T reaction rate in a tritium plasma have also been calculated for various assumed values of the plasma ion temperature.

Plasma Stability

Refer also to abstracts 27211 and 27303.

25643 (CONF-760209-12) IMPURITY BEAM-TRAPPING INSTABILITY IN TOKAMAKS. Hogan, J. T.; Howe, H. C. (Oak Ridge National Lab., Tenn. (USA)). 1976. 23p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

The sensitivity of neutron energy production to the impurity trapping of injected neutral beams is considered. This process is affected by inherent low-Z contamination of the tritium preheat plasma, by the species composition of the neutral beam, and by the entrance angle of the beam. The sensitivities of the process to these variables, and to the variation of wall material are compared. One finds that successful use of a low-Z, low-sputtering material can appreciably lengthen the useful pulse length. (auth)

25644 (COO-1478-14) THEORETICAL INVESTIGATIONS RELEVANT TO CONTROLLED FUSION RESEARCH. Progress Report, January 31, 1975–January 31, 1976. Kammash, T. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Jan 1976. Contract AT(11-1)-1478. 7p. Dep. NTIS $3.50.

The main research effort was directed at two major categories of problems associated with plasma confinement in mirror machines and tokamaks. In the latter case the emphasis was on the effect of runaway electrons on the overall stability of the system while for the open-ended devices much of the effort went into examining the impact of finite beta and feedback stabilization on loss cone modes as well as some investigations in the reactor aspects of mirror confined plasmas. The highlights of these studies along with some of the results are described. (MOW)

25645 (COO-2059-51) SIMULATION OF PARAMETRIC INSTABILITY EFFECTS IN A BEAM PLASMA SYSTEM. Hubbard, R. F. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Dec 1975. 231p. Dep. NTIS $8.00.

Thesis.

An energetic electron beam produces large amplitude resonant plasma oscillations which can parametrically decay into growing nonresonant electron and ion waves if ion dynamics are included. A similar parametric instability occurs in a plasma driven by a high frequency external electric field. A two-specie particle simulation study of beam generated parametric instabilities is presented and the results compared with corresponding one-specie beam and external field simulations. For low beam densities the individual nonresonant modes grow approximately at the rates predicted by parametric instability theory. This growth eventually causes the resonant plasma oscillations to decay exponentially at a rate proportional to the original parametric growth rate. f/sub e/(v) develops suprathermal tails which eventually lead to a stable non-Maxwellian plasma with a field energy spectrum W/sub k/ approximately k^{-2} as seen in external field simulations. The velocity diffusion coefficient has been measured from test particle dynamics, and beam plasmas driven by an external field have been simulated. Also, the possible role of the parametric instability in stabilizing the beam against deceleration has been studied, and the inclusion of parametric threshold effects lead to more stringent requirements for parametric stabilization than had been previously assumed. The consequences for several astrophysical and laboratory plasma systems are discussed.

25646 (LA-620-4MS) TWO-STEP MODEL OF SCYLLAC EQUILIBRIUM. Miller, G. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 80. Dep. NTIS $4.50.

The simplest sharp boundary MHD equilibrium theory of Scyllac, assuming nearly cylindrical geometry, is extended to a two-step plasma beta profile. Generalizations of the standard equilibrium formulas are given. (auth)

25647 (UCI-75-14) FILAMENTARY INSTABILITIES OF ROTATING ELECTRON BEAMS. Molvig, K.; Benford, G.; Condit, W. C. Jr. (California Univ., Irvine (USA). Dept. of Physics; California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract AT(04-3)-34. 46p. Dep. NTIS $4.00.

A rotating, relativistic electron beam is highly unstable if its net current is neutralized by a background plasma. The beam breaks up into a series of concentric doughnuts (ring tearing). The external magnetic field cannot inhibit this k equals k/sub z/ perturbation. Growth rates are calculated in the thin beam approximation. Numerical simulations bear out the linear growth times. Growth saturates when the relativistic electrons are sufficiently thermalized to satisfy a pinch equilibrium condition and they oscillate in the magnetic wells formed by the field perturbations. An additional feature of the mode in this geometry is a radial electrostatic field which is necessary to drive the cross-field current.

25648 (UCI-75-41) SURFACE FILAMENTATION OF A RELATIVISTIC ELECTRON BEAM IN A PLASMA. Molvig, K.; Roberson, C. W. (California Univ., Irvine (USA). Dept. of Physics). 1975. Contract AT(04-3)34. 21p. Dep. NTIS $3.50.

The electromagnetic instability of a relativistic electron beam in a plasma that is current and charge neutralized in the beam channel. In addition to the usual filamentary instability one finds an instability that is localized to the surface of the beam. The large azimuthal mode number growth rate in cylindrical geometry is omega/sub i/ equals omega/sub b// radical 2 gamma. The effects of collisions, a conducting wall, magnetic field, hollow beam geometry and different plasma densities, inside and outside the beam, are calculated.

25649 THRESHOLDS OF PARAMETRIC INSTABILITIES NEAR THE LOWER-HYBRID FREQUENCY. Berger, R.L.; Perkins, F.W. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 19: No. 3, 406-411 (Mar 1976).

Resonant decay instabilities of a pump wave with frequency ω_0 near the lower-hybrid frequency ω_{lh} are analyzed with respect to the wavenumber k of the decay waves and the ratio ω_0/ω_{lh} to determine the decay process with the minimum threshold. It was found that the lowest thresholds are for decay into an electron plasma (lower-hybrid) wave plus either a backward ion-cyclotron wave, an ion Bernstein wave, or a low-frequency sound wave. For $\omega_0 < (2\omega_{lh})^{1/2}$, it was found that these decay processes can occur and have faster growth than ion quasi-modes provided the drift velocity, (cE_0/B_0) is much less than the sound speed. In many cases of interest, electromagnetic corrections to the lower-hybrid wave rule out decay into all but short wavelength ($k\rho_i > 1$) waves. The experimental results are consistent with the linear theory of parametric instabilities in a homogeneous plasma. (auth)

25650 MAGNETOHYDRODYNAMICS OF AXISYMMETRIC REACTORS FROM THE DRIFT-KINETIC EQUATION. Cheung, L. (Charmain Heights, Block A1, 7th Floor, Eastbourne Road, Kowloon, Hong Kong). Phys. Rev. A 13: No. 3, 1209-1218 (Mar 1976).

The magnetohydrodynamic drift-kinetic equation has been derived by means of the small-gyroradius expansion. The small-gyroradius expansion derived here employs the magnetohydrodynamic ordering. Using this small-gyroradius expansion, all the relevant transport coefficients are systematically evaluated. These results include both diagonal and cross coefficients for the particle fluxes, heat flux, and electric current. By combining the transport coefficients with appropriate moments of the drift equation, a closed set of equations which accurately summarizes the significance of these equations, in particular with regard to recent axisymmetric reactor experiments, provides an extension of the Chew-Goldberger-Low equations, now valid when the thermal velocity is comparable to the electric drift. The generalized equations may be used to investigate the macroscopic stability theory of doublet plasmas. (auth)

25651 PARAMETRIC RESONANCE INSTABILITIES IN ARGON AND NEON PLASMAS. Cicconi, G.; Rosatelli, C. (Istituto di Elettrotecnica, University of Genoa, Italy). J. Appl. Phys. 47: No. 3, 922-929 (Mar 1976).

Experimental results, interpreted by a theoretical model based on the first two hydrodynamic equations, concerning parametric resonance instabilities in argon and neon dc discharges are presented. These instabilities were detected by scattered microwaves in the frequency band 2–40 GHz when the plasma positive column was pierced across a rectangular waveguide, by measuring time-modulation enhancement due to striation eigenmodes built-up in plasmas. (auth)

25652 STABILITY OF A BEAM MOVING WITH VARYING VELOCITY. Bliokh, Yu.P.; Buts, V.A.; Izmailov, A.N. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 20: No. 7, 883-887 (July 1975).

A theoretical and experimental study has been made of the stability of a beam whose velocity varies periodically with a coordinate. Expressions are found for the growth rates of longitudinal and transverse waves both with and without a strong external magnetic field. It is shown that the maximum growth rate arises when the conditions for double parametric resonance are satisfied. The possibility of direct parametric excitation of transverse waves is demonstrated experimentally. (auth)

25653 SCALING OF PLASMA TURBULENCE RESULTING FROM PARAMETRIC INSTABILITIES. Ott, E. (Department of Engineering, Cornell University, Ithaca, New York 14850). Phys. Fluids 19: No. 2, 341-341 (Feb 1976).

Dimensional analysis is used to obtain results on the turbulent state resulting from parametric instabilities of an initially cold plasma. The results include the possibility of an applied magnetic field, multiple ion species, and arbitrary dimensionality. (auth)

25654 STABILITY LIMITS OF THE ION BEAM EXCITED ELECTROSTATIC ION CYCLOTRON INSTABILITY. Michelsen, P. (Association Eurotom, Atomenergikommissionen, Danish Atomic Energy Commission Research Establishment Risø, Roskilde, Denmark). Phys. Fluids 19: No. 2, 337-339 (Feb 1976).

The dispersion relation for low-frequency electrostatic waves was analyzed numerically to find the region of instability for an ion beam plasma versus beam velocity v_b, and versus electron to ion temperature ratio. For $V_b > 1.6\ a$ the marginal unstable mode has a perpendicular wavenumber $k_\perp \neq 0$. (auth)

25655 ENERGY LOST BY A RELATIVISTIC ELECTRON BEAM DUE TO TWO-STREAM INSTABILITY. Thode, L.E. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Phys. Fluids 19: No. 2, 305-315 (Feb 1976).

The two-stream instability between a monoenergetic relativistic electron beam of energy $\gamma_0\ mc^2$ and density n_b and an unmagnetized, homogeneous plasma of density n_e is investigated. For weak interactions, $S = \beta_0^2 \gamma_0 (n_b/2n_e)^{1/3} < 0.45$, the two-stream spectrum is predominantly one-dimensional, and the fractional beam energy loss is $\Delta E = S(1+S)^{-5/2}$. However, for strong interactions, $S > 0.45$, efficient coupling occurs to waves with perpendicular wavenumbers $0 > k_\perp < (n_b/n_e)^{1/3}\ \omega_e/c$. Independent of $S\ \Delta E \simeq 0.18$ for strong interactions. The analysis is supported by one- and two-dimensional computer simulations. In addition, it is observed that nonlinear wave particle interactions lead to rapid heating of the plasma in two-dimensional space. Symmetric bulk heating and high energy tail formation of plasma electrons is observed perpendicular to the beam direction. Plasma heating parallel to the beam is asymmetric ($v > 0$), since the large amplitude waves are generated as a result of beam trapping in the forward direction. (auth)

25656 ENERGY LOST BY A RELATIVISTIC ELECTRON BEAM PROPAGATING ALONG AN EXTERNAL MAGNETIC FIELD. Thode, L.E.; Godfrey, B.B. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico §7545). Phys. Fluids 19: No. 2, 316-320 (Feb 1976).

The nonlinear interaction between a relativistic electron beam and a homogeneous, magnetized plasma is discussed. The plasma heating as a function of guide magnetic field strength is obtained by comparing three two-dimensional, fully electromagnetic numerical simulations. The interaction involves a $(\gamma_0 - 1)mc^2 = 1.5$ meV monoenergetic beam with a beam-to-plasma density ratio of $n_b/n_e = 10^{-1}$. The zero and moderate magnetic field interactions are strongly two-dimensional in character, in agreement with theory. The strong magnetic field case is similar to a one-dimensional interaction. The presence of the magnetic field appears to reduce high energy tail formation perpendicular to the beam. Nonlinear Landau damping is observed to be an important process in two-dimensional space. (auth)

25657 ION-CYCLOTRON WAVES IN NONUNIFORM PLASMAS AND PARAMETRIC INSTABILITIES. Sperling, J.L.; Perkins, F.W. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 19: No. 2, 281-292 (Feb 1976).

A general formalism for studying waves propagating in a plasma with density and magnetic field gradients in slab geometry is discussed. Specializing to electrostatic ion-cyclotron waves propagating perpendicular to the gradients, it is shown that a density profile can lead to local or nonlocal structure around points where $N'(x)/N(x)$ has a local maximum while inhomogeneous magnetic fields provide the wave with the profile of an Airy function. Application of the formalism to parametric instabilities driven by magnetosonic waves and with $k_y\rho_i \gg 1$ is discussed. In particular, it is concluded that density and magnetic field gradients should not be critical in the development of the cyclotron decay instability in the FM-1 (floating multipole-1), ATC (adiabatic toroidal compressor), and PLT (Princeton large torus) devices of Princeton. (auth)

25658 HIGH-FREQUENCY FLUTE INSTABILITY WITH LOSS-CONE DISTRIBUTION FUNCTION. Hirose, A. (Department of Physics, University of Saskatchewan, Saskatoon, Saskatchewan, Canada, S7N 0W0). Phys. Fluids 19: No. 2, 272-275 (Feb 1976).

The effect of a loss-cone-shaped distribution function on the current-driven, high-frequency flute mode has been investigated. The effect becomes significant when the wavelength is of the same order as the electron Larmor radius and, in general, tends to destabilize the instability. (auth)

25659 EFFECTS OF LOW-FREQUENCY FLUCTUATIONS ON THE GROWTH OR DECAY OF HIGH-FREQUENCY MODES. Escande, D.F. (Laboratoire de Physique des Milieux Ionisés, Groupe de Recherche du Centre National de la Recherche Scientifique, Ecole Polytechnique, Plateau de Palaiseau, 91120, Palaiseau, France). Phys. Fluids 19: No. 2, 256-259 (Feb 1976).

The problem of high-frequency modes propagating in a plasma where density fluctuations are large enough to produce plasmon reflections is investigated. The special cases of an instability and of a locally excited damped wave are considered. (auth)

25660 CURRENT-DRIVEN INTERNAL KINK MODES IN CYLINDRICAL AND HELICOIDAL DISCHARGES. Edery, D. (35, Boulevard Brune, 75680 Paris, France); Laval, G.; Pellat, R.; Soulé, J.L. Phys. Fluids 19: No. 2, 260-265 (Feb 1976).

The stability of the internal $m=1$ kink mode is shown to be very sensitive to small distortions of a circular cylindrical equilibrium.

Cylindrical and helicoidal $m=2$ distortions are destabilizing. Triangular $m=3$ and quadrangular $m=4$ distortions provide a means of stabilizing the internal kind mode. (auth)

25661 ION-BEAM—DRIVEN RESONANT ION-CYCLOTRON INSTABILITY. Hendel, H.W.; Yamada, M.; Seiler, S.W. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540); Ikezi, H. Phys. Rev. Lett. 36: No. 6, 319-322 (9 Feb 1976).

The resonant ion-beam—driven electrostatic ion-cyclotron instability is identified. Measured dispersion relation and onset versus beam energy and density agree with numerical calculations based on a theory which includes beam-acoustic terms. After amplitude saturation, velocity-space diffusion of the beam ions is observed. (auth)

25662 ANOMALOUS ABSORPTION OF LIGHT BY A NONISOTHERMAL PLASMA. Galeev, A.A.; Lominadze, D.G.; Machabeli, G.Z. (Institute of Physics of the Academy of Sciences, Gruz SSR, Tbilisi). Sov. Phys.—Tech. Phys. 20: No. 7, 862-864 (July 1975).

The nonlinear development of a parametric instability in a nonisothermal plasma is studied. The spectral composition of the decay ion-acoustic and plasma modes is investigated in the one-dimensional model; the nonlinear damping is computed. (auth)

25663 LINEAR THEORY OF TRANSVERSE CURRENT INSTABILITIES IN A PLASMA. II. Aref'ev, V.I. Sov. Phys.—Tech. Phys. 20: No. 7, 892-901 (July 1975).

It is shown that high-frequency transverse-current instabilities at the leading edge of a shock wave produce an anomalous resistivity and strong dissipation of the magnetic field energy. The structure of the leading edge of a magnetoacoustic shock wave in a turbulent plasma is investigated on the basis of an equation describing the high-frequency stability condition. The characteristic damping scale of the magnetic field is determined, and estimates are obtained for the turbulent conductivity and the effective frequency of scattering of electrons by fluctuations for various transverse-current instabilities. (auth)

25664 SELF-GRAVITATIONAL INSTABILITY OF A STRATIFIED PLASMA IN THE PRESENCE OF HALL CURRENTS. Bhatia, P. K.; Maheshwari, S. L. (Univ. of Jodhpur, India). Indian J. Phys.; 49: No. 6, 440-449(Jun 1975).

The hydromagnetic stability of a self-gravitating, incompressible, inviscid, infinitely conducting plasma of variable density in the presence of the effect of Hall Currents was studied. The prevailing magnetic field is assumed to be uniform and acting along the vertical. It is first shown that a variational principle characterizes the problem. Proper solutions have then been obtained, by the variational methods, for a semi-infinite plasma having a one-dimensional (exponential) density gradient along the vertical direction. The dispersion relation has been solved numerically and it is found that the growth rate increases with Hall currents, exhibiting thereby the destabilizing character of Hall currents on the dynamic stability of a stratified plasma.

Thermonuclear Engineering and Equipment

Refer also to abstracts 25753, 25754, 26400, 26608, 26792, 26832, and 26838.

25665 (AD/A-006250) LASER-FUSION STUDIES AT NRL. A Report to AEC for the Period, July 1973 to June 1974. Stamper, J. A.; Levine, L. S. (Naval Research Lab., Washington, D. C. (USA)). Oct 1974. 191p. (NRL-7838). NTIS $7.00.

Work done at NRL on laser-fusion-related problems during FY 1974 is summarized. Included are sections related to laser development and to experimental and theoretical studies of laser–plasma interactions. (GRA)

25666 (BNWL-1973) BIOMAGNETIC EFFECTS: A CONSIDERATION IN FUSION REACTOR DEVELOPMENT. Mahlum, D. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1976. Contract E(45-1)-1830. 27p. Dep. NTIS $5.00.

Fusion as a power source is receiving an increasing amount of attention. Several designs have been proposed and the feasibility of each alternative is being studied. As we move closer to a working design, attention can be paid to potential biological hazards. Large magnetic fields and the emission of tritium and lithium are unique to some fusion reactor designs. The results of a review of the current state of knowledge concerning the biological effects of magnetic fields alone and in combination with ionizing radiation are summarized in this report. The purpose of the review is to help identify areas where additional biomedical research is needed for establishing guidelines for reactor design and operation. 64 references (auth)

25667 (CONF-760209-4) PLASMA-WALL INTERACTION IN ATC DURING HIGH POWER NEUTRAL BEAM INJECTION. Cohen, S. A. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1976. 21p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Measurements of the elemental composition of the vacuum vessel wall surface and impurity influx into ATC during high power beam-heated discharges are combined with previous measurements of power balance and scaling laws to give a self consistent model of plasma-wall interaction in ATC. It is shown that plasma charge exchange induced desorption is the main cause of impurity influx during neutral beam injection. Impurities change the net power balance in these beam-heated discharges by approximately 15 percent. (auth)

25668 (CONF-760415-1) COATINGS APPLICATION FOR FUSION RESEARCH. Simpkins, J. E. (Oak Ridge National Lab., Tenn. (USA)). 1976. 17p. Dep. NTIS $3.50.

From international conference on metallurgical coatings; San Francisco, California, United States of America (USA) (5 Apr 1976).

A large stainless steel toroidal inner vacuum liner, with a major radius of 79.5 cm and minor radius of 23.5 cm, has been coated with gold to minimize gas adsorption and to provide an inert surface for the plasma in ORMAK, a fusion experiment. A thin platinum film, deposited prior to the gold coating, acts as a diffusion barrier and prevents many of the constituents of the steel substrate from diffusing through the gold to the surface. In a fusion reactor the walls exposed to the plasma will be bombarded by highly energetic neutrals and a gold surface may not be suitable because of its relatively high sputtering yield. Several other materials, some of which may be more suitable for use as a "first wall" surface than gold have been identified but many of these candidates are expected to be impractical to use in their bulk form. A solution is a composite wall consisting of a suitable coating on a substrate chosen for its strength and ease of fabrication. The techniques employed to deposit several of these candidate materials onto stainless steel substrates as thick coatings are described.

25669 (COO-2234-9) PELLETS FOR FUSION REACTOR REFUELING. Annual Progress Report, 1 January 1975–31 December 1975. Turnbull, R. J. (Illinois Univ., Urbana (USA)). Jan 1976. Contract E(11-1)-2234. 91p. Dep. NTIS $5.00.

The feasibility of refueling fusion reactors using pellets of deuterium-tritium is discussed. A pellet injector has been constructed and experiments have been done injecting solid pellets into the ORMAK machine. Theoretical explanations of the results from these experiments have been successful. Other experiments underway include techniques for charging the pellets in order to accelerate and control them.

25670 (ERDA-76-34) FUSION POWER RESEARCH AND DEVELOPMENT. Summary Report on Magnetic Confinement Experiments. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Controlled Thermonuclear Research). Jan 1976. 78p. Dep. NTIS $5.00.

The report is divided into five sections which discuss, respectively, Tokamaks, Theta Pinches, Mirrors, Z Pinches, and Elmo Bumpy Torus. Each section contains a brief introduction to the general principles of the confinement concept together with a discussion of the relevant machine and plasma parameters. The overview is followed by a description of each device including the name of the device, the laboratory, the principal investigator, the DCTR contact, a brief discussion of the nature and purpose of the device, the machine and plasma parameters, and the major results of the device. Finally, a summary table of parameters is provided.

25671 (EUR-CEA-FC-763(Pt. 1)) ANNUAL PROGRESS REPORT OF THE FONTENAY-AUX-ROSES RESEARCH GROUP, JANUARY 1 TO DECEMBER 31, 1974. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd]. 115p. (In French). INIS.

The salient events of 1974 were the full-time working of TFR at Fontenay-aux-Roses and the building of Petula and Wega at Grenoble. The remounting of TFR after reinforcement of the vacuum chamber was followed by an increase in the small plasma radius by elimination of the copper shell to prolong the present program. In agreement with the Culham laboratory a common

program to develop the injection of neutral particles up to the performance needed for the JET has begun. At Grenoble the mounting of Petula was finished and the technological problems of the vacuum chamber (metallic joints for the alumina-metal joints) have been solved. The mounting of Wega was pursued simultaneously with that of Petula within the European context of a collaboration with Garching and the Royal Military School. In the "Ionized Gas Theory Section" work was centered on: M.H.D. equilibrium and stability, plasma development in Tokamaks, waves, transport and convection, spectroscopy, microinstabilities and turbulence. Fundamental physics covers the subjects: EQUATOR, EOS-POP and ODE experiments, HCN laser and atomic collisions. The activity in open configuration concerned the experiment Billeen-Tete MB. (FR)

25672 (JAERI-M-5898) OPTIMUM DESIGN OF OHMIC HEATING FIELD COILS FOR AN AIR-CORE SYSTEM AND EQUILIBRIUM FIELD COILS OF A LARGE SCALE FUSION DEVICE. Kobayashi, Tomofumi; Tamura, Sanae; Tani, Keiji. (Japan Atomic Energy Research Inst., Tokyo). Nov 1974. 84p. (In Japanese). INIS.

Numerical methods are presented for determining optimum configuration of ohmic heating (OH) field coils for an air-core system and equilibrium field coils of a large scale fusion device. In one method, the currents of the prescribed positions are optimized to produce a required magnetic field by a linear programming optimization procedure. The other method is an application of the virtual-casing principle developed by Zakharov and determines simultaneously the currents and their positions of a system of coils. These methods are applied successfully to the determination of the optimum configuration of the OH coils and the equilibrium field coils of a large tokamak currently under design at JAERI. (auth)

25673 (LA-6203-MS) OHMICALLY HEATED HIGH-DENSITY Z PINCH. Hammel, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 5p. Dep. NTIS $4.50.

The gross properties of a high-density (n approximately equal to 10^{27} m^{-3}), small-radius, (r equals 10^{-4} m) gas-imbedded Z pinch have been examined considering only classical processes. The rate equation using only ohmic heating along with bremsstrahlung and radial heat transport shows that ohmic heating will rapidly take the pinch to thermonuclear temperatures for currents, I, greater than 1 MA. The radial heat loss for the pinch is very small for I greater than 1.5 MA. This suggests that the pinch could tolerate being driven to a nearby wall by an m equals 1 kink. The laser technology for initiation of the small-diameter filament and the high-voltage technology for giving a 30-ns rise to a MA or more are available now. Some reactor considerations have been included. (auth)

25674 (LBL-3399(Suppl.), pp II.7.1-II.7.4) ION OPTICS OF A SINGLE STAGE POST-ACCELERATION SYSTEM. Thompson, E. (UKAEA, Oxfordshire, Eng.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

This is treated analytically in the same manner as the single aperture extraction system in which the initial convergence of the beam is balanced by the lens action of the aperture in the acceleration electrode. The problem is illustrated by considering circularly symmetric apertures. (MOW)

25675 (LBL-3399(Suppl.), pp II.9.1-II.9.4) EXTRACTION OF ENERGY FROM HIGH INTENSITY ION BEAMS. Forrester, A. T. (Univ. of California, Los Angeles). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

In order to restrain electron flow to the collector when ions are decelerated, it is proposed here that a magnetic field B perpendicular to the direction of ion flow and parallel to the collector surface be used. Under these conditions there is a flow of electrons executing cycloid-like paths in a direction perpendicular to both B and the ion beam. The potential variation in the double sheath which exists between the ion beam plasma and the collector surface has been found analytically, and equations from which the required values of B, electron cross-current, and sheath thickness can be ascertained, have been developed. The parameters appear to be of convenient size for all useful ion beams. (auth)

25676 (LBL-3399(Suppl.), pp III.1.1-III.1.7) PRINCIPLES OF THE REFLEX TRIODE HIGH CURRENT PULSED ION ACCELERATOR. Humphries, S. Jr. (Cornell Univ., Ithica, NY). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The reflex triode pulsed ion accelerator, developed at Cornell, has successfully produced equivalent proton output currents in excess of 6 kiloamperes at 20 amps/cm^2 for pulse lengths of about 50 nanoseconds. Energies up to 300 keV have been investigated with maximum energy conversion efficiencies of 42 per cent. The principles of operation with mesh anodes are discussed with a review of current experimental results. A theory of triode operation at high energies using plastic foil anodes is presented. The model indicates that it may be possible to achieve efficiencies near unity and ion current densities in excess of the Langmuir-Child limit. An accelerator under construction in which it is hoped to obtain over 50 kiloamperes at 3 MeV is discussed. (auth)

25677 (LBL-3399(Suppl.), pp III.4.1-III.4.6) SIX STAGE HALL ACCELERATOR. Cole, H. C.; Saunders, B. D.; Naylor, G. O. R.; Terry, M. J. (UKAEA Association for Fusion Research, Oxon, Eng.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The main design features of the accelerator are described. Performance characteristics in the range of 20 kV and 10 A to 4 kV and 70 A are given. It is shown that beam power densities of approximately 80 W/cm^2 can be obtained at a distance of 20 cm from the outlet. Values of efficiency ranging from approximately 70 percent for high voltage, low current operation down to approximately 10 percent for high current, low voltage operation are obtained. The optimum running conditions are at approximately 50 kW input at which efficiency is approximately 25 percent. Collimation of the output beam is estimated and it is shown that approximately 70 percent of the output power is delivered in a half angle of approximately 10^0. Comparison is made with earlier two stage accelerators and with ion sources. (auth)

25678 (LBL-3399(Suppl.), pp III.5.1-III.5.5) D^+ ION SOURCE FOR THE PRODUCTION OF NEGATIVE D^- IONS. Geller, R. (CEN, Grenoble, France); Jacquot, C.; Sermet, P. 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

One of the propositions for making an intense (10 MW at 1 MeV) beam of neutral D^0 atoms requires a flux of D^- ions of 12 mA/cm^2 over a large area. These D^- ions can be created from D^+ ions by charge exchange in a cesium target. A source of D^+ ions was constructed that is both efficient (40 percent ionization of input gas) and of high quality (60 mA/cm^2 at 1.5 keV). A plasma having a density of 10^{12} cm^{-3} is created in a magnetic mirror field by rf heating at the electron cyclotron frequency (prf equals 300 W-f rf equals 10 GHz) in a background pressure of approximately 10^{-4} torr. Extraction electrodes spaced approximately 0.7 mm apart permit the extraction of 6 mA of D^+ through a 2.4 mm diameter hole or 1.2 mA of D^+ through 1 mm by 1 mm slit. The construction of a larger plasma (10 cm in diameter) will be investigated by using a packet of parallel waveguides. By choosing a proper spatial modulation of the rf power output, the resulting plasma will be radially uniform to better than 10 percent. (auth)

25679 (LBL-3399(Suppl.), pp VI.1.1-VI.1.9) HIGH INTENSITY ION SOURCES FOR THERMONUCLEAR RESEARCH AND DEVELOPMENT. Morgan, O. B. (Oak Ridge National Lab., TN). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Ion sources delivering 10's of A equivalent of hydrogen neutral particles at energies of 10 to 30 keV are crucial elements in the present U. S. thermonuclear program. Future fusion requirements include extending the energy of these high current accelerators to 100's of keV. The development of these systems has been concentrated primarily at the Lawrence Livermore Laboratory, the Lawrence Berkeley Laboratory and the Oak Ridge National Laboratory. These programs have developed the intense multi-aperture ion sources that depend on large uniform plasmas and carefully designed extraction electrode geometries to focus the ions into a closely coupled hydrogen gas cell. The LBL-10 module produces approximately 10 to 16A of hydrogen ions at 10 to 20 keV for a pulse length of up to 30 msec. The ORNL duoPIGatron system

produces 6 to 10 A at 15 to 40 keV for up to 300 msec with a 15 percent duty cycle. The LBL-50 produces 50 to 80 A at approximately 20 keV for 10 msec. These programs are presently undertaking research and development efforts to scale these or other beam modules to the 100's of keV steady state systems needed for fusion reactors. There are also ion source applications for plasma wall surface studies and materials neutron radiation damage studies that are important for fusion reactor development. (auth)

25680 (LBL-3399(Suppl.), pp VI.5.1-VI.5.6) STEADY-STATE EXTRACTION OF MULTI-AMPERE ION BEAMS FROM THE BPD SOURCE PLASMA. Nunogaki, M.; Naito, M.; Akimune, H.; Suita, T. (Osaka Univ.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The source plasma is generated in the two stages in space. The first stage is of a hot-cathode discharge in magnetic field, and in the second stage the plasma from the first is reformed to be proper for the ion extraction. When the hydrogen plasma is produced by firing a single hole discharge in the first stage, a preliminary extraction of ion beam in steady-state has been tried. The total current of 1.17 amperes was obtained at 30 kV through the 7-apertures of 9-mm-diam. The current density reaches 260 mA/cm^2. With the four-arc discharge, the flat distribution of source plasma with the density of 10^{12} to 10^{13} cm^{-3} is attained over the area of about 6 cm in diameter. (auth)

25681 (LBL-3399(Suppl.), pp VI.8.1-VI.8.4) MULTIAPERTURE SOURCE FOR THE PRODUCTION OF LOW ENERGY NEUTRAL BEAMS USING MOLECULAR IONS. Coupland, J. R.; Thompson, E. (UKAEA, Oxfordshire, Eng.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The construction and performance of a quasi dc multiaperture ion source and extraction system which has been developed for use on the Culham Superconducting Levitron experiment are described. Unlike other experiments utilizing neutral injection heating, which operate at energies greater than or equal to 20 keV with time scales approximately 10's of ms, the requirements for the levitron include relatively low energy less than or equal to 10 keV long plus length greater than or equal to 1 sec, and furthermore the input geometry is somewhat restrictive. (auth)

25682 (LBL-3399(Suppl.), pp VI.9.1-VI.9.3) DUOPIGATRON ION SOURCE AND NEUTRAL INJECTION HEATING IN ORMAK. Jernigan, T. C.; Davis, R. C.; Morgan, O. B.; Schechter, D. E.; Stewart, L. D.; Stirling, W. L.; Wright, R. E. (Oak Ridge National Lab., TN). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Two duoPIGatron ion sources with closely coupled gas cells have been applied to ORMAK for neutral beam heating experiments at 200 kW of injected power. Two additional sources are now being added. To meet these power requirements plus the varied requirements necessary for experimental verification of neutral beam heating in tokamaks, modifications and operation in regimes not previously encountered on the test stand have been necessary. Use of focusing multi-aperture electrodes has increased the neutral power deliverable into the ORMAK plasma by 50 percent to the present 100 kW level per injector. At the 25 kV extraction voltage now used, power densities of greater than 5 kW/cm^2 have been obtained. The addition of focusing electrodes also allows the possibility of matching irregularly shaped entrance apertures in plasma devices. (auth)

25683 (LBL-3399(Suppl.), pp VI.11.1-VI.11.4) ION SOURCE WITH RADIAL DISCHARGE IN THE CUSP MAGNETIC FIELD. Semashko, N. N.; Pleshivtsev, N. V.; Kuznetsov, V. V.; Maximenko, B. P.; Malakhov, N. P. (I. V. Kurchatov Inst. of Atomic Energy, Moscow). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The ion source, with the large emission surface designed to obtain intensive beams of hydrogen ions with the current intensity of tens of amperes for injectors of fusion installations, is described. The source is placed in the cusp magnetic field. A discharge is ignited near the median surface of the field along the magnetic force line over the radius between the cylindrical cathode and external anode located coaxially, forming the plasma ring. Its lateral surface serves as an ion emitter. The ion concentration in the plasma with the large emission surface doesn't decrease with the increase of radius of emission ring slits, since the magnetic field strength increases over the radius. Ions are extracted from the plasma across the magnetic force lines and accelerated by means of three-electrodes electrostatic system along the longitudinal axes of solenoids, generating the cusp magnetic field. Experiments were carried out with one and two ring slits of emission with width 2 mm and mean diameter 130 and 160 mm. The discharge current reached 500 A. The average density of emission current of ions amounted to 0.8 A/sm^2. The current in beam of ions under 40 keV exceeded 16 A. (auth)

25684 (LBL-3399(Suppl.), pp VI.13.1-VI.13.6) OPTIMIZATION OF ION SOURCES FOR CONTROLLED FUSION RESEARCH APPLICATIONS. Woo, J. T.; Mensing, A. E. (United Aircraft Research Labs., East Hartford, CT). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The prospect for improvements in the performance of ion sources for controlled fusion research applications is investigated from a theoretical point of view. The objectives are identified in terms of beam energy, intensity, purity and power efficiency. By analyzing the process in the extraction and formation of an ion beam, an expression is obtained which relates the parameters of the ion source to the quality of the beam. The implications of the result in improving the performance of the ion source for CTR applications is discussed. (auth)

25685 (LBL-3399(Suppl.), pp VII.3.1-VII.3.5) APPLICATIONS OF NEUTRAL BEAM SOURCES IN SCIENCE AND TECHNOLOGY. Bauer, W.; EerNisse, E. P.; Mattern, P. L.; Musket, R. G.; Schmieder, R. W.; Thomas, G. J. (Sandia Labs., Livermore, CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Potential applications of neutral beam sources in science and technology, excluding the primary use of heating CTR plasmas, have been studied and evaluated. The most practical and immediately useful applications are in CTR-related materials research and testing. Novel and potentially useful advantages may be obtained in the use of neutral beam sources for production of neutrons and X rays, and for pumping lasers and masers. Utilization of these sources for machining glasses and ceramics and implanting atoms in metals and semi-conductors also appears promising. (auth)

25686 (LBL-3399(Suppl.), pp VII.10.1-VII.10.4) TWO DUOPLASMATRONS USED FOR D-T FUSION NEUTRON SOURCE. Kim, J.; Hilton, J. L.; Hendry, G. O. (Cyclotron Corp., Berkeley, CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Two duoplasmatron ion sources are employed in a single stage accelerator to produce D-T mixed beams. Mixed D-T ions are accelerated into both sides of a water-cooled chromium-plated copper-tube target, whereby T(d,n)^{4}He reactions occur yielding 14 MeV neutrons. Each source is capable of producing a steady D-T mixed beam of 190 mA at 200 keV. The effective beam spot is approximately 5.5 cm dia. At the typical operating condition of 170 kV and 300 mA total beam current, the neutron yields are, respectively, approximately 5 x 10^{10} n/sec when pure deuterium gas is used and approximately 6 x 10^{12} n/sec when D-T equally mixed gas is used. (auth)

25687 (ORNL/TM-5035) NEUTRONIC SCOPING STUDIES FOR THE TOKAMAK EXPERIMENTAL POWER REACTOR. Santoro, R. T.; Bettis, E. S.; McAlees, D. G.; Watts, H. L.; Williams, M. L. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 29p. Dep. NTIS $5.00.

One-dimensional neutron and photon radiation transport methods have been used to investigate candidate blanket configurations and compositions for use in the Tokamak Experimental Power

Reactor. Seven blanket designs are compared in terms of energy recovery, radiation attenuation, potential radiation damage, and, where applicable, tritium breeding. (auth)

25688 (SAND-75-0562) EXPLOSIVE GENERATOR DEVELOPMENT FOR THE SHIVA PROGRAM. Progress Report, January 1, 1975–June 30, 1975. Butler, R.; Duggin, B. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 27p. Dep. NTIS $4.50.

A series of experiments performed by SLA, Division 5233, has culminated in two parallel plate explosive generator tests for the SHIVA program. The experimental generators were one-sided devices, 150 mm wide and 600 mm long with a spacing of 50 mm between the explosively driven and the stationary plates. Significant new features in these generators included (1) high point density initiation over the entire 150 mm x 600 mm surface of the driver charge with an electrically exploded copper mesh, and (2) use of a distended copper plate for the wiped surface at the load end of the generator. The distended copper plate minimized formation of a metallic jet at the interface between the driven and wiped plates. Both explosive generator tests reached current gains of about 8 and energy gains of about 4 despite early termination of generation associated with the arrival of a conductive shock front in the helium atmosphere.

25689 (SAND-76-5203) ENGINEERING CONCEPTS IN FUSION. Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1976. 18p. (CONF-760215-2). Dep. NTIS $3.50.

From 16th annual ASME symposium on energy alternatives; Albuquerque, New Mexico, United States of America (USA) (26 Feb 1976).

The major approaches to controlled fusion are described. Some of the engineering concepts involved with each approach are outlined. (MOW)

25690 (UCID-17030) ESTIMATE OF ENERGY DENSITY ON CYCLOPS SPATIAL FILTER PINHOLE STRUCTURE. Guch, S. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1974. Contract W-7405-Eng-48. 7p. Dep. NTIS $3.50.

The inclusion of a spatial filter between the B and C stages in CYCLOPS to reduce the effects of small-scale beam self-focusing is discussed. An estimate is made of the energy density to which the pinhole will be subjected, and the survivability of various pinhole materials and designs is discussed. (MOW)

25691 (UCID-17031) HIGH POWER SPATIAL FILTER CONSIDERATIONS, WITH SPECIAL EMPHASIS ON THE CYCLOPS GEOMETRY. Simmons, W. W.; Guch, S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Sep 1974. Contract W-7405-Eng-48. 30p. Dep. NTIS $4.00.

This document presents considerations leading to location and first-cut design of a lens-pinhole-lens spatial filter for Cyclops laser chain. Small scale beam break-up is the driving phenomenon for spatial filtering, and design is predicated upon estimates of this effect's magnitude. The departure of the beam from diffraction limited performance (due to astigmatism and to whole beam self-focusing) is presented in terms of pinhole size limitations. All calculations are presented in terms of parameters associated with Cyclops, through the B stages, assuming that the spatial filter is located at this point in the chain, and that the focal length of the input spatial filter lens is 100 cm. The geometrical ray diagram is shown.

25692 (UCID-17055) DT FUSION NEUTRON IRRADIATION OF BNL-LASL SUPERCONDUCTOR WIRES, BPNL NICKEL AND MOLYBDENUM, ORNL MAGNESIUM OXIDE, UW-LLL METALLIC FOILS, AND LLL ALUMINUM TENSILE. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Nov 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $3.50.

The experimental procedure for testing the samples is given. No test results are indicated. (MOW)

25693 (UCID-17075) DT FUSION NEUTRON IRRADIATION OF LLL COPPER TENSILE SPECIMENS AT 210^{0}C AND SLL FIBER OPTIC BUNDLES. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Dec 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $3.50.

The experimental procedure for testing the samples is given. No test results are indicated. (MOW)

25694 (UCRL-50035-75(Vol.1)) THEORETICAL PHYSICS DIVISION ANNUAL REPORT, JANUARY-DECEMBER 1975. Volume 1. Wainwright, T.; Tarter, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jan 1976. Contract W-7405-Eng-48. 113p. Dep. NTIS $5.45.

Discussions of theoretical work during this period are reported for the following general areas: (1) atomic, molecular, and nuclear physics, (2) laser fusion, propagation, and effects, (3) pulsed power and plasma physics, (4) energy and the environment, and (5) related research. (MOW)

25695 (UCRL-75885) LASER DRIVEN ISOTHERMAL IMPLOSIONS. Dahlbacka, G.; Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Oct 1976. 18p. (CONF-741079-20). Dep. NTIS $3.50.

From 16th annual meeting of the plasma physics division of the American Physical Society; Albuquerque, New Mexico, USA (28 Oct 1974).

A review of laser-compression experiments is given. Diagrams illustrating various compression data are described. (MOW)

25696 (UCRL-77072) NEUTRON TIME-OF-FLIGHT SPECTROMETER FOR LASER-FUSION EXPERIMENTS. Lerche, R. A.; Coleman, L. W.; Houghton, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 19p. (CONF-751130-24). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

The basic concept of a time-of-flight spectrometer is illustrated. The spectrometer described can measure 14.1-MeV neutrons coming directly from the D-T plasma and also neutrons scattered by the air or ground or other structures within the vicinity of the flight path. (MOW)

25697 (UCRL-77149(Rev. 1)) ENERGY FLUX LIMITATION BY TAME TURBULENCE. Manheimer, W. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Feb 1976. Contract W-7405-Eng-48. 21p. (CONF-751130-25). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A quasi-linear theory of energy flux limitation by ion acoustic turbulence is presented. This distribution function is modelled by a Maxwellian plus an additional piece which carries a heat flux Q. By taking the fourth moment of the Vlasov equation one finds the anomalous thermal conductivity K approximately 3 v/sub e/ lambda/sub De/ (e phi/T/sub e/)$^{-2}$. Other moments treated self-consistently include anomalous ion heating, electron cooling, current generation and enhanced inverse bremsstrahlung due to the nonthermal ion fluctuations. (auth)

25698 (UCRL-77231) LASER FUSION TARGET CHAMBER DESIGN. O'Neal, W. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Nov 1975. 5p. (CONF-751125-140). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The SHIVA laser system, which is being built at LLL, consists of a 1.06 mu m master oscillator whose 100 picosecond output pulse is beam split into 20 laser amplifier chains, each outputting 1 terawatt for a total of 20 TW with optical aberration of $^1/_2$ wave. Before firing, the beams are automatically aimed at the target within 5 microradians and focused within 7 mu m. Computer calculations predict significant thermonuclear burn will be achieved with this system. (MOW)

25699 (UCRL-77406) LASER MICRODRILLING IN THE FABRICATION OF LASER FUSION TARGETS. Weinstein, B. W.; Hendricks, C. D.; Weir, J. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 9p. (CONF-751130-31). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A brief discussion on the use and performance of laser microdrilling is given. The fabrication of a "ball-in-plate" fusion target is described. (MOW)

25700 (UCRL-77731) RECENT DEVELOPMENTS IN LASER PLASMA THEORY AND SIMULATIONS. Kruer, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-eng-48. 19p. Dep. NTIS $3.50.

The principal recent developments are that (1) nonlinear steepening of the density profile strongly modifies absorption processes near the critical density, (2) a sizeable stimulated reflection of light can occur, and (3) energy transport by hot electrons is impeded either by the need to draw a return current, by ion fluctuations generated by this return current, or by self-generated magnetic fields. A brief overview of these results is presented.

25701 (UCRL-77796) CONTROL OF FIRST-WALL SURFACE CONDITIONS IN THE 2XIIB MAGNETIC MIRROR PLASMA CONFINEMENT EXPERIMENT. Simonen, T. C.; Bulmer, R. H.; Coensgen, F. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Feb 1976. 20p. (CONF-760209-3). Dep. NTIS $3.50.

From 2nd international conference on surface effects in con-

trolled fusion devices; San Francisco, California, United States of America, (USA) (16 Feb 1976).

The control of first-wall surface conditions in the 2XIIB Magnetic Mirror Plasma Confinement experiment is described. Before each plasma shot, the first wall is covered with a freshly gettered titanium surface. Up to 5 MW of neutral beam power has been injected into 2XIIB, resulting in first-wall bombardment fluxes of 10^{17} atoms.cm^{-2},s^{-1} of 13-keV mean energy deuterium atoms for several ms. The background gas flux is measured with a calibrated, 11-channel, fast-atom detector. Background gas levels are found to depend on surface conditions, injected beam current, and beam pulse duration. For our best operating conditions, an effective reflux coefficient of 0.3 can be inferred from the measurements. Experiments with long-duration and high-current beam injection are limited by charge exchange; however, experiments with shorter beam duration are not limited by first-wall surface conditions. It is concluded that surface effects will be reduced further with smoother walls. (auth)

25702 SPECTRA AND ABSOLUTE YIELD OF CHARGED PARTICLES GENERATED AS A RESULT OF LASER-INITIATED FUSION REACTIONS. Gus'kov, S.Yu.; Krokhin, O.N.; Rozanov, V.B. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 10, 1260-1264 (Oct 1975).

Analytic results are obtained for the spectra and absolute yields of charged products of fusion reactions escaping from a laser plasma. It is shown that the dimensions, density, and temperature of the compressed core of a laser plasma can be determined from experimentally measured charged-particle spectra and yields by applying the results derived in the present paper. (auth)

25703 PLASMA COMPRESSION BY AN EXPLOSIVELY-DRIVEN CONDUCTING LINER. Churaev, V.A.; Lobanov, K.M.; Fedyakov, V.P.; Dyatlov, V.D.; Timonin, A.M. (D. V. Efremov Scientific Research Institute for Electrophysical Apparatus, Leningrad). Sov. Phys.—Tech. Phys. 20: No. 7, 873-875 (July 1975).

The optimal parameters of the system (geometry, amount of explosive, initial plasma temperature and density) are computed as functions of the required efficiency, k_p, near $k_s=1$, which corresponds to the Lawson criterion. (auth)

25704 BUCKLING OF A SUPERCONDUCTING COIL NESTED IN A THREE-COIL TOROIDAL SEGMENT. Moon, F.C. (Department of Theoretical and Applied Mechanics, Cornell University, Ithaca, New York 14853). J. Appl. Phys. 47: No. 3, 920-921 (Mar 1976).

Measurements are made of the lateral stiffness of a flexible planar superconducting coil between two rigid coils in series. These tests show a dramatic decrease in the natural bending frequency with subsequent elastic instability or "buckling" at a critical value of the current in the coils. These observations support a magnetoelastic analysis which shows that proposed designs of toroidal field coils for Tokamak fusion reactors have insufficient lateral support for mechanical stability of the magnets. (auth)

25705 VIBRATION AND STABILITY OF A SET OF SUPERCONDUCTING TOROIDAL MAGNETS. Moon, F.C.; Swanson, C. (Department of Theoretical and Applied Mechanics, Cornell University, Ithaca, New York 14853). J. Appl. Phys. 47: No. 3, 914-919 (Mar 1976).

The vibration and elastic stability of a set of discrete superconducting magnets arranged to form a "bumpy" toroidal field is examined. The mutual destabilizing magnetic forces between magnet pairs are calculated using a numerical differential inductance technique. It is shown that the mutual attractive magnetic forces can produce elastic buckling of the entire toroidal set. Using the theory of periodic structures, the vibration modes of the set are found as functions of the coil current. The response of the set of magnets to an earthquake-type motion of the toroidal base is also calculated. (auth)

25706 POSSIBLE DETERMINATION OF TARGET DENSITY FOR LASER THERMONUCLEAR FUSION FROM SCATTERING OF THERMONUCLEAR NEUTRONS BY THE TARGET MATERIAL. Gamalii, E.G.; Rozanov, V.B.; Sobolevskii, N.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 11, 1389-1390 (Nov 1975).

An analysis is made of the scattering, on the target nuclei, of neutrons formed during heating and compression of a laser fusion target. The Monte Carlo method is used to calculate the distortion of the DD-neutron spectrum due to the scattering by a spherical target of deuterated polyethylene $(CD_2)_n$. The calculations are carried out for a model (constant) and realistic profiles of the target core $\rho(r)$, where r is the distance from the target center. It is shown that the number of scattered neutrons n is n one-to-one correspondence with the optical thickness along the target radius. If the density is constant, we have $n=\text{const}\ \rho^{2/3}$. The results obtained can be used in determination of the density of experimental targets. (auth)

25707 POLOIDAL STRUCTURE OF THE DISSIPATIVE TRAPPED ELECTRON DRIFT INSTABILITY. Liewer, P.C.; Manheimer, W.M. (Naval Research Laboratory, Washington, D.C. 20375); Tang, W.M. Phys. Fluids 19: No. 2, 276-280 (Feb 1976).

A study of the poloidal mode structure of the dissipative trapped electron drift mode by Fourier analysis shows that when ion inertia effects are small compared with trapped electron effects, the mode balloons out in the region of trapped particles. When ion inertia effects are large, there is no ballooning and the growth rates are correspondingly smaller. (auth)

25708 PROBLEMS POSED BY THE REALIZATION OF A THERMONUCLEAR REACTOR. Bonnal, J. F.; Leloup, C. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Entropie; 11: No. 61, 10-24(1975). (In French)

The physics of plasma production and confinement is in constant progress and the production of a thermonuclear plasma would appear to be feasible in the near future. The main technical problems to be solved before the achievement of an economical thermonuclear reactor are reviewed. The principal characteristics of a thermonuclear plasma and reactor are discussed; in particular, the main dimensions and power level are deduced. A toroidal confinement reactor of the Tokomak type is described. Finally, some characteristics of laser fusion and other reactor models are discussed briefly. (FR)

25709 STUDY OF A FAST CIRCUIT BREAKER FOR HIGH CURRENTS. Delmas, A.; Rioux, C.; Rioux-Damidau, F. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Plasmas). Rev. Phys. Appl.; 10: No. 4, 241-245(Jul 1975). (In French)

The circuit breaker presented here is capable of interrupting a 10kA current within 1μs and then sustaining an over voltage of the order of 20kV for a 3mm insulation width. The construction is of the mechanical rupture type in which the replacement of a piece of conductor by an insulator is ensured by means of the explosion of a stoichiometric mixture of hydrogen and oxygen. The current is then transferred into a fuse which finally transfers the energy to the load or opens the circuit. (FR)

25710 THE TOKOMAK OF FONTENAY-AUX-ROSES. Ginot, P.; Torossian, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Entropie; 11: No. 61, 25-40(1975). (In French)

The Tokomak of Fontenay-aux-Roses (TFR) has been built in order to increase the performances obtained with the same type of machine by the Soviet physicists. The current induced into the plasma has reached 0.4MA, the main magnetic field being 60kG. A plasma with a mean electron density of 4.5 10^{13} cm^{-3}, a maximum electron temperature of 2.5keV and a maximum ion temperature of 1keV has been obtained in hydrogen and deuterium. The discharge duration has attained 0.5sec. These results agree with those obtained before. (FR)

25711 MAGNITUDE OF THE MAGNETIC FIELD PRODUCED IN A LASER PLASMA. Nastoyashchii, A. F. Sov. At. Energy (Engl. Transl.); 38: No. 1, 30-32(Jan 1975).

Translated from At. Energ. (USSR); 38: No. 1, 27-28(Jan 1975).

Saturation mechanisms are found that limits the value of the magnetic field. It was assumed that the laser-produced plasma borders on a material wall which absorbs heat so that a temperature (and density) gradient arises in a direction away from the wall and toward the plasma. In addition, there is a pressure gradient along the wall. (MOW)

Wave Phenomena

25712 (AD/A-006461) A LARGE QUIESCENT MAGNETIZED PLASMA FOR WAVE STUDIES. Gekelman, W.; Stenzel, R. L. (California Univ., Los angeles (USA). Plasma Physics Group). Dec 1974. 42p. (PPG-194). *NTIS* $3.75.

The development of a large magnetized plasma for wave propagation experiments is described. The method employs a dc discharge in a weak magnetic field region and subsequent particle diffusion into a strong uniform B-field region. Plasma diagnostics with probes, microwaves, and spectroscopy for steady state and afterglow are described. Examples of wave propagation for ion acoustic waves, electron Bernstein waves and lower hybrid waves indicate the versatility of the device. (GRA)

25713 (ITF-74-23-R) ELECTROMAGNETIC FLUCTUATIONS IN THE HALF-SPACE OF NONEQUILIBRIUM PLASMA.

Popov, V. S.; Yakimenko, I. P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 22p. (In Russian). INIS. 14 refs.

The boundary value problem was solved for the fluctuational field in the case when the electrons drift as a whole relative to the ions. The spectral densities of the space correlations of electron, ion and total charges were found. The frequency domains in which plasma is transparent were investigated in detail. It was indicated that the introducing of plasma boundary affects strongly the fluctuation spectrum in such domains; in particular, the possibility of the existence of new branches (in respect to the case of unbounded plasma) of critical fluctuations was predicted.

25714 (RT/FIMA-(75)3) REFLEX: A PROGRAM TO CALCULATE THE SCATTERING BY A PLASMA COLUMN IN A RECTANGULAR WAVEGUIDE. Benedetti, A. P.; Poli, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sep 1975. 31p. Dep. NTIS (US Sales Only) $4.00.

The program Reflex calculates the reflection and transmission coefficients of a plasma column placed transversally across a rectangular waveguide, when the probing electric field, that propagates in TE_{10} mode, is parallel to the axis of the column. Account is taken both of the nonuniform electron density distribution of the plasma and of the glass sleeve, or of any other dielectric material, containing the plasma. The program gives electric fields transmitted and reflected as a function of fixed points in waveguide.

25715 (UCI-75-45) EXCITATION OF ION CYCLOTRON HARMONIC WAVES WITH AN ION BEAM OF HIGH PERPENDICULAR ENERGY. Boehmer, H. (California Univ., Irvine (USA). Dept. of Physics). 1974. Contract AT(04-3)-34. 18p. Dep. NTIS $3.50.

Preliminary experimental results are reported on the interaction of a rotating ion beam with a plasma in an external magnetic field. The predominant feature is that the beam ions have an energy component perpendicular to the magnetic field which is large compared to the energy of the background plasma ions. It is shown that the interaction leads to the excitation of ion cyclotron harmonic waves.

25716 MODE CONVERSION AND TUNNELING AT THE TWO-ION HYBRID RESONANCE. Swanson, D.G. (Department of Electrical Engineering, University of Southern California, Los Angeles, California 90007). Phys. Rev. Lett. 36: No. 6, 316-319 (9 Feb 1976).

I investigate the two-ion hybrid resonance for a warm, collisionless plasma and find an approximate dispersion relation appropriate for a toroidal fusion plasma. The fast Alfvén wave propagates on both sides of the resonance, so the tunneling factor is calculated and for fusion plasmas it is found that fast waves incident from the high-magnetic-field side will undergo mode conversion to an ion-Bernstein mode and those incident from the low-field side will be reflected. (auth)

25717 EXCITATION OF ION-ACOUSTIC WAVE BY POWER-MODULATED ELECTROMAGNETIC WAVE IN A WEAKLY IONIZED PLASMA. Yamamoto, T.; Nishio, Y.; Tsukishima, T. (Department of Electrical Engineering, Nagoya University, Nagoya, Japan). Phys. Fluids 19: No. 3, 483-484 (Mar 1976).

It is shown that the electromagnetic ponderomotive force f^{el} of a locally irradiated microwave beam is mainly responsible for the excitation of an ion-acoustic wave, even when the ionization effect is taken into consideration. (auth)

25718 ENHANCED COHERENT RAMAN EMISSION FROM UNIFORM PLASMAS. Prasad, B. (Air Force Cambridge Research Laboratories, Hanscom Air Force Base, Massachusetts 01731). Phys. Fluids 19: No. 3, 464-478 (Mar 1976).

A mechanism for the coherent emission of radio and microwaves from a warm uniform plasma is proposed. The output power from this mechanism appears to have the characteristics of a classical parametric amplification process. An earlier kinetic theory model for radiation by the scattering of plasma waves in a homogeneous plasma is revamped and modified to incorporate the dominant role of longitudinal Rayleigh scattered waves which stimulate the emission of transverse combination radiation (sum and difference of impressed and natural frequencies) by the resonant Raman scattering process in the plasma. This results in intense radio or microwave radiation at approximately twice the plasma frequency, the intensity depending upon plasma parameters. This intensity, its angular pattern, and the threshold condition for its enhanced emission are calculated. Comparisons of the computed results with the laboratory observation of the radiation output from dc discharges in argon gas, and from a helium theta-pinch plasma are made. Both qualitative and quantitative agreement are found. (auth)

25719 UNSTABLE ELECTROSTATIC ION CYCLOTRON WAVES EXCITED BY AN ION BEAM. Michelsen, P.; Pécseli, H.L.; Rasmussen, J.J.; Sato, N. (Association Euratom-Atomenergikomissionen, Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark). Phys. Fluids 19: No. 3, 453-456 (Mar 1976).

Electrostatic ion cyclotron waves were observed in a quiescent cesium plasma into which a low-energy beam of sodium ions was injected. The instability appeared when the beam velocity was above 12 times the ion thermal velocity. The waves propagated along the magnetic field with a velocity somewhat smaller than that of the beam. The dispersion relation was in good agreement with theory. (auth)

25720 ION-BEAM EXCITATION OF ELECTROSTATIC ION-CYCLOTRON WAVES. Böhmer, H.; Hauck, J.P.; Rynn, N. (Physics Department, University of California, Irvine, California 92717). Phys. Fluids 19: No. 3, 450-452 (Mar 1976).

Electrostatic ion-cyclotron waves are excited by a cesium ion beam injected into a cesium plasma in a Q machine. Strong interactions are observed. Spatial growth rates are measured as a function of beam and plasma parameters. (auth)

25721 PROPAGATION OF UNSTABLE WAVES IN A RANDOM MEDIUM: DIFFUSIVE AND NONDIFFUSIVE EFFECTS. Coste, J.; Peyraud, J. (Laboratoire de Physique de la Matière Condensée, Parc Valrose, 0611 Nice, France). Phys. Fluids 19: No. 3, 372-387 (Mar 1976).

The propagation of unstable wavepackets (or modes) in a one-dimensional fluid is studied in the presence of space–time dependent fluctuations. It is shown that the fluctuations have two effects: They diffuse the modes in k space and they produce, through a short scale average, a renormalization of their growth rate. In a WKB approximation the evolution of the unstable spectrum is governed by equations which generalize the usual diffusion equation. (auth)

25722 ELECTROMAGNETIC FLUCTUATIONS IN A SEMI-INFINITE NONEQUILIBRIUM PLASMA. Popov, V.S.; Yakimenko, I.P. (Institute of Theoretical Physics, Ukrainian Academy of Sciences). Sov. Phys.–Tech. Phys. 20: No. 7, 876-879 (July 1975).

The boundary-value problem has been solved for the fluctuation field in a semi-infinite nonequilibrium plasma in the presence of directed motion of the electrons relative to the ions. The spectral densities are found for the spatial correlation of electron, ion, and total charge densities. The transparency regions of the plasma are investigated in detail. We show that introducing an interface substantially modifies the spectra of fluctuations in these regions. We demonstrate, in particular, that there can exist new branches (with respect to the infinite plasma case) of the critical fluctuations. (auth)

25723 VAN DER POL'S EQUATION AND NONLINEAR OSCILLATIONS IN A BEAM PLASMA SYSTEM. Walsh, J.E.; Hagelin, J.S. (Department of Physics and Astronomy, Dartmouth College, Hanover, New Hampshire 03755). Phys. Fluids 19: No. 2, 339-340 (Feb 1976).

A nonlinear dispersion relation for beam plasma oscillations is obtained by expanding the usual dispersion relation about both the most unstable root and the perturbed beam electron orbits. This procedure leads to a nonlinear rate equation similar to the van der Pol equation. (auth)

25724 SHEAR INDUCED GROWTH AND DAMPING OF WAVES. Manheimer, W.M. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 19: No. 2, 335-337 (Feb 1976).

It is shown very simply with a time domain analysis that shear always stabilizes positive or negative energy waves. If the mode energy changes sign as a function of position, however, shear may destabilize the wave. (auth)

25725 ANOMALOUS ABSORPTION NEAR THE LOWER-HYBRID FREQUENCY. Fidone, I.; Granata, G. (Association Euratom-CEA sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, 92260 Fontenay-aux-Roses, France). Phys. Fluids 19: No. 2, 293-298 (Feb 1976).

Turbulent absorption of a wave with a frequency near or above the lower-hybrid frequency in a parametrically unstable plasma is investigated. The analysis is restricted to the transitory quasi-linear stage of the development of the instability. Within the quasi-linear framework, the effect of the driven turbulence on the spatial damping of the pump wave and the mode conversion efficiency at the lower-hybrid resonance is discussed. It is found that, at a moderate level of the turbulent noise ($W/n_0T_e \simeq 10^{-6}$), the pump wave experiences an appreciable dissipative effect. (auth)

25726 EXCITATION OF THE ORDINARY ELECTROMAGNETIC MODE IN LOW-β PLASMAS. Freund, H.P. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Wu, C.S. Phys. Fluids 19: No. 2, 299-304 (Feb 1976).

The excitation of the ordinary mode propagating perpendicular to an external magnetic field in a plasma with low β_i is discussed. The analysis is performed for plasma in which in addition to the thermal

electrons there is a hot anisotropic electron component. Relativistic effects are taken into account in the stability analysis. Both a ring distribution and a loss cone distribution are used to model the hot electron species. For the ring distribution typical growth rates are larger than that for the case of the loss cone distribution. Excitation of the ordinary mode is found at numerous harmonics of the cyclotron frequency for the ring distribution, however, the loss cone distribution is found to give instability primarily at the fundamental harmonic. (auth)

25727 CYLINDRICAL SOLITONS IN A WARM, MULTI-ION PLASMA. Maxon, S. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 19: No. 2, 266-271 (Feb 1976).

The soliton problem for ion acoustic waves propagating in a warm plasma consisting of a mixture of two ion species is solved for cylindrically symmetric ingoing waves. The small amplitude approximation is made and a modified Korteweg–de Vries equation is obtained. The early time solution shows that the solitons for the two ion species plasma are narrower in spatial width and propagate faster than their counterpart in the single ion plasma. Also, a given initial disturbance will break up into more solitons in the multi-ion, warm plasma than in the cold single-ion plasma. (auth)

25728 SATURATION OF TWO-PLASMON PARAMETRIC DECAY BY INTEGRATED TRANSFER THROUGH THE SPECTRUM. Degtyarev, L.M.; Pustovalov, V.V.; Silin, V.P.; Tikhonchuk, V.T. (Institute of Applied Mathematics, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Tech. Phys. 20: No. 7, 865-869 (July 1975).

A study is made of the nonlinear stage in the development of a parametric instability in which a pump wave decays into two plasmons, the instability being saturated by the induced scattering of the plasmons on ions. It is shown that in a cold plasma, in which the transfer through the spectrum has an integrated character, the instability relaxes in a qualitatively different way from the previously studied case of a hot plasma, in which the transfer is differential. The oscillations of the energy density of the plasma waves about the quasistationary level are nonperiodic and rapidly damped. The time required to establish a quasistationary turbulent state is of the order of 25 maximum reciprocal growth rates of the parametric excitation, so that parametric turbulence can fully develop in the majority of experiments in which intense radiation interacts with a plasma. The spectral distribution of the plasma noise which arises in the integrated transfer is a line which gets narrower with the time and is situated at the boundary of the instability region. The time required to establish a quasistationary spectrum of the plasmons is appreciably longer than the time required to establish the total noise. (auth)

25729 TRANSFORMATION OF A PLASMA WAVE AT A PLASMA–VACUUM BOUNDARY. Govorun, E.Ya.; Skal'ko, L.A. (G. S. Skovoroda Khar'kov State Pedagogical Institute). Sov. Phys.—Tech. Phys. 20: No. 7, 880-882 (July 1975).

A study is made of the transformation of a plasma wave into transverse electromagnetic waves for different angles of incidence. It is shown that fairly effective transformation is not confined to small angles of incidence. A study is made of the angles of incidence for which the electromagnetic waves become surface waves or undergo total internal reflection. The conditions of effective transformation into surface electromagnetic waves are determined. (auth)

25730 STRUCTURE OF SHOCK WAVES OF "SWITCHING". Ledenev, V. G. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Irkutsk, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1594-1597(1975). (In Russian)

An exact solution of equations is found for two-liquid magnetohydrodynamics with "ion dispersion" describing the structure of a shock wave propagating along the magnetic field in a low pressure ($p \ll H^2/8\pi$) plasma. (auth)

ENGINEERING

25731 (SAND-75-0426) SANDIA TECHNOLOGY, AUTUMN 1975. Weber, J.; Mead, P. (eds.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 33p. Dep. NTIS $5.00.

A separate abstract was prepared for each of the six sections for ERDA Energy Research Abstracts (ERA). In addition, two sections were abstracted for NSA. (RCK)

For abstracts of individual sections see: 25929 and 26906.

Energy Conversion

25732 (FE-1208-1) DEVELOPMENT PROGRAM FOR MHD POWER GENERATION. Interim Technical Report June 1974. (Avco-Everett Research Lab., Everett, Mass. (USA)). Jun 1974. 250p. Dep. NTIS $8.00.

A total of 33,000 kilowatt hours of accumulated operating experience has been built up on the Mark VI MHD generator experiment. A total absence of arcing during the last 68 hours indicates that this major determinant of long-duration reliability has been brought under control, and a new Avco-designed burner has been put in service which has made possible, on a routine basis, power-levels in the Mark VI of from 400 to 500 kilowatts. A metal tubular air preheater and compressor have been ordered for the purpose of reducing the hourly consumption of liquid oxidizer, thus allowing more hours of operation between refills. Testing of the high-temperature air heater has also yielded highly satisfactory results. To date, air preheat temperatures of 3000^{0}F and higher have been reached in continuous cyclic operation for more than 600 hours. Alumina cored brick is the heater matrix and the mode of operation corresponds to separate firing. Air preheat temperature strongly influences the overall efficiency of an MHD plant and an efficiency of between 55-60 percent is possible with the performance obtained to date. Detailed analysis of the radiation cooling and kinetics of the MHD generator exhaust gas in the radiant section of the downstream boiler, have shown that the level of NO/sub x/ can be reduced to a fraction of the corresponding EPA standard in a furnace of reasonable size.

25733 MAGNETOHYDRODYNAMIC INSTABILITY OF A CYLINDRICAL LIQUID-METAL BRUSH. Hong, S.H.; Wilhelm, H.E. (Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80523). J. Appl. Phys. 47: No. 3, 906-913 (Mar 1976).

The stability of a homopolar generator brush, consisting of a liquid-metal-filled cavity between rotating (rotor) and fixed (stator) cylinder electrodes, is analyzed in the presence of radial current transport and an axial homogeneous magnetic field. Within the frame of linear magnetohydrodynamics, it is shown that the liquid-metal flow in the brush is always unstable if the brush transports current. In the absence of current flow (infinite load) the axial magnetic field stabilizes the liquid-metal flow in the brush if the magnetic energy density is larger than a certain fraction of the energy density of the rotating fluid. (auth)

Facilities and Equipment

Refer also to abstracts 25909, 26114, 26403, 26954, 26955, and 27562.

25734 (AD/A-008412) ANNUAL PROGRESS REPORT NO. 88 COVERING PERIOD JANUARY 1, 1974-DECEMBER 31, 1974. (Harvard Univ., Cambridge, Mass. (USA). Div. of Engineering and Applied Physics). Apr 1975. Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005. 77p. NTIS $4.75.

Report on the Joint Services Electronics Program. See also report dated Oct 1973, AD-770143.

Contents include very low frequency wave propagation; electron and solid state physics; control theory and applications; electromagnetic phenomena; coupled antennas and arrays; antennas and waves in and over dielectric, conducting, and plasma media. (GRA)

25735 (LMEC-TDR-75-14) SPTF THERMAL INSULATION PERFORMANCE TEST. Armstrong, G. R. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 1975. Contract E(04-3)-700. 64p. AT.

The results of a test program conducted at the Liquid Metal Engineering Center (LMEC) to determine the performance characteristics of the thermal insulation used on the Class A piping in the Sodium Pump Test Facility (SPTF) are described. The insulation was installed on a section of 16-in. pipe and operated for 1273 hr at 1050^{0}F. Post-test examination of the assembly did not reveal any evidence to indicate that the insulation was detrimental to the stainless steel piping.

25736 (ORNL/TM-5309) LABORATORY SERVICES SERIES: AN ELECTRICAL OUTLET AND CORDED EQUIPMENT INSPECTION PROGRAM. Davis, E. A. (Oak Ridge National Lab., Tenn. (USA)). Apr 1976. Contract W-7405-eng-26. 15p. Dep. NTIS $3.50.

A research and development laboratory has thousands of electrical outlets providing power to laboratories, offices, shops, and service areas. These outlets provide power for a wide variety of portable equipment and tools that are equipped with cord and plug. Electric safety requires a periodic check of outlet grounding capability and continuing inspection and repair of corded equipment. Personnel, equipment, reports, procedures, and schedule requirements are reported.

25737 (UCRL-50028-75-2, pp 39-45) COMPUTER SIMULATIONS GROUP. 1975.

In H-Division quarterly report, April-June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

This group is responsible for calculations in the general area of solid mechanics. Work currently underway includes long-rod-penetrator mechanics, armor design, three-dimensional analysis of a gas turbine stator blade, definition of missile-silo environment from penetrating nuclear weapons, and aircraft-hangerette vulnerability. Code development associated directly with this work includes modifications of finite difference and finite element computer programs and the companion graphics software. (auth)

25738 KEY-AND-KEYWAY COUPLING FOR TRANSMITTING TORQUE. Blue, S. C.; Curtis, M. T.; Orthwein, W. C.; Stitt, D. H. (to U.S. Energy Research and Development Administration). US Patent 3,920,343. F16D1/08. 18 Nov 1975. Filed date 13 Nov 1974. 6p.

PAT-APPL-523,377.

The design of an improved key-and-keyway coupling for the transmission of torque is given. The coupling provides significant reductions in stress concentrations in the vicinity of the key and keyway. The keyway is designed with a flat-bottomed u-shaped portion whose inboard end terminates in a ramp which is dished transversely, so that the surface of the ramp as viewed in transverse section defines an outwardly concave arc.

25739 VOLUMETRIC DISPENSER FOR SMALL PARTICLES FROM PLURAL SOURCES. Bradley, R. A.; Miller, W. H.; Sease, J. D. (to U.S. Energy Research and Development Administration). US Patent 3,926,344. G01F11/28. 16 Dec 1975. Filed date 20 Jun 1974. 6p.

PAT-APPL-481,422.

Apparatus is described for rapidly and accurately dispensing measured volumes of small particles from a supply hopper. The apparatus includes an adjustable, vertically oriented measuring tube and orifice member defining the volume to be dispensed, a ball plug valve for selectively closing the bottom end of the orifice member, and a compression valve for selectively closing the top end of the measuring tube. A supply hopper is disposed above and in gravity flow communication with the measuring tube. Properly sequenced opening and closing of the two valves provides accurate volumetric discharge through the ball plug valve. A dispensing system is described wherein several appropriately sized measuring tubes, orifice members, and associated valves are arranged to operate contemporaneously to facilitate blending of different particles.

25740 LEAK TESTING OF EQUIPMENT INTENDED FOR NUCLEAR INDUSTRY. Cadeau, J. (Bureau Veritas, 75- Paris (France)). pp 47-69 of Meeting on Leak Detection and Helium-Tightness Tests. May 16, 1972. Proceedings. Paris, France; Comite Francais d'Etude des Essais Non Destructifs [nd]. (In French)

From meeting on leak detection and and helium-tightness tests; Paris, France (16 May 1972). Special edition of Revue de Metallurgie and Soudage et Techniques connexes.

Equipment intended for nuclear industry is tested during and after manufacture and after mounting. The methods used are reviewed with special emphasis on helium testing and on the pressure rise and pressure drop methods. (FR)

Lasers

Refer also to abstracts 25688, 25690, 25691, 26390, 26514, 27266, and 27267.

25741 (AD/A-005294) LASER ENERGY EVALUATOR (LEE): LABORATORY AND FIELD TESTS. Final Report, Oct 1972-Jun 1974. Labo, J. A.; Marston, D. R.; Laudieri, P. C. (School of Aerospace Medicine, Brooks AFB, Tex. (USA)). Dec 1974. 20p. (SAM-TR-74-50). NTIS $3.25.

The Laser Energy Evaluator (LEE) is intended for use by Air Force laser safety personnel to: (1) confirm Safe Eye Exposure Distance (SEED) calculations by direct measurement, (2) test for possible hazardous reflections from an operating laser system, and (3) facilitate laser hazard surveys as required by AFR 161-24. The calibration tests showed that the LEE measured laser output intensities on the same order as the Permissible Exposure Levels to within +- 10 percent of each energy or power scale reading. The user tests show that the LEE could be used as a field device, but has some inherent limitations. (GRA)

25742 (AD/A-006034) SPECTRAL EMITTANCE MEASUREMENTS ON SOME LASER WINDOW MATERIALS. Physical Sciences Research Papers. Skolnik, L. H. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 2 Dec 1974. 22p. (AFCRL-PSRP-615; AFCRL-TR-74-0590). NTIS $3.25.

A cryogenic emittance spectrometer for measuring absorption coefficients in the 2.5 to 14 micrometer region is described. The spectrometer is modular in design and uses a liquid nitrogen-cooled circular variable filter (CVF) as the monochromator element. By using an electrically heated sample holder, temperature as well as frequency dependence of the absorption coefficient is obtained. Some representative spectra of high resistivity GaAs, CVD ZnSe, and RAP KCl are presented. GaAs appears to be at least partially dominated by multiphonon absorption near 10.6 micrometers, while both ZnSe and KCl show intrinsic loss mechanisms in this region at room temperature. (GRA)

25743 (AD/A-006101) INVESTIGATE MATERIAL SYSTEMS FOR MIRRORS USED IN HIGH POWER CO AND CO_2 LASERS. Final Technical Report. Stewart, R. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1974. Contract N00123-72-C-2215. 79p. NTIS $4.75.

See also report dated Aug 1973, AD-769103.

This report is aimed at demonstrating the viability of a mirror structure concept formed by sputter deposited materials. The mirror concept would be used in high energy CO, CO_2, and other infrared laser systems at the infrared wave length of 10.6 mu. Sputtered deposits of Cu-1 vol percent SiC on a variety of metal substrates provided surfaces that could be reproducibly polished using conventional techniques to an rms roughness of 20 A or less. Sputter-deposited germanium and CdTe were found to have optical properties near those of bulk material. Sputter deposition of quarter-wavelength reflectivity enhancement coatings therefore appears feasible. The results of limited laser damage testing were exceptional considering that there was not time to optimize material properties. (GRA)

25744 (AD/A-006197) PROBLEMS OF THE GAMMA RAY LASER. Report for 1 May 1973-1 Jun 1974. Baldwin, G. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). Aug 1974. 145p. NTIS $5.75.

This report is addressed to the problem of the state-of-the-art of gamma ray laser development. It is intended to identify the various disciplines and specific research areas which can best contribute to resolving the question of "graser" feasibility. Topics discussed include the following: the basic mechanisms of laser action; gamma ray emission from nuclear isomers; the resonance cross section; nonresonant absorption; photon kinetics; inhomogeneous line breadths; and problems of pumping. (GRA)

25745 (AD/A-007046) A COMPARATIVE STUDY OF THREE-WAVE, FOUR-WAVE AND HIGHER-ORDER-WAVE PARAMETRIC PROCESSES. Final Report, Mar-Nov 1974. Corbin, J. C. Jr. (Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Dec 1974. 201p. (ARL-74-0177). NTIS $7.25.

This report examines three-wave, four-wave, and higher-order-wave parametric processes taking into account pump depletion. The theory for both three-wave forward traveling wave (FTW) and backward traveling wave (BTW) interactions is reviewed. A comprehensive comparison of three possible down conversion systems and three up conversion systems is made based on a common set of system parameters consisting of input pump excitation and the ratio of input signal to pump photon flux. Of the down conversion systems, the system consisting of a BTW at the signal frequency and a FTW at the pump frequency most efficiently transfers energy from the pump wave for any given level of pump excitation or ratio of signal/pump photon flux. In up conversion, the system consisting of two forward traveling waves at the pump and signal frequencies is the most efficient. (GRA)

25746 (AD/A-007791) LASER WINDOW SURFACE FINISHING AND COATING TECHNOLOGY. Final Report, 1 May 1973-31 Jan 1975. Braunstein, M.; Braunstein, A. I.; Allen, S. D.; Gentile, A. L.; Giuliano, C. R. (Hughes Research Labs., Malibu, Calif. (USA)). Jan 1975. Contract F19628-73-C-0243. 103p. NTIS $5.25.

See also report dated Aug 1974, AD/A-003666.

The program covered six areas of study: surface finishing, surface characterization, coating techniques, optical evaluation, chemical analysis, and laser window damage studies. Potassium chloride surfaces have been produced on reactive atmosphere processed (RAP) KCl using HCl etching which show an order of magnitude improvement in KCl surface damage resistance. An etch-polish procedure is reported for ZnSe which results in a significant decrease in surface absorption. An inverse dependence of 10.6 mu optical absorption of film deposition rate is reported for germanium films. Ultrahigh vacuum deposited ThF_4 films were found to have minimum absorptions of about 10/cm. Rutherford backscattering for chemical analysis of films and window surface structure promises to be a new powerful technique. A unique modulated light ellipsometer which can operate over a broad wavelength range in the uv, visible, near ir, and 10.6 mu was constructed. (GRA)

25747 (AD/A-007838) DEVELOPMENT OF CHALCOPYRITE CRYSTALS FOR NONLINEAR OPTICAL APPLICATIONS. Final Report, 30 Jun 1972-31 Oct 1974. Begley, R. F.; Byer, R. L.; Chemla, D. S.; Choy, M. M.; Herbst, R. L. (Stanford Univ., Calif. (USA). Microwave Lab.) 1 Dec 1974. Contract F33615-72-C-2011. 144p. (ML-2387). NTIS $5.75.

This final report summarizes recent progress in the growth of three chalcopyrite crystals, CdGeAs2, AgGaSe2, and AgGaS2. Recent applications of these crystals to the generation of tunable infrared radiation have been more actively pursued as a result of a number of important requirements for tunable sources. The treatment includes a discussion of third and fourth harmonic generation. Recent work in AgGaSe2 for infrared generation by mixing is presented as a reprint in Appendix III. Also included in Appendix IV is a preprint of a paper describing a new model for the calculation of second order nonlinear susceptibilities. The Bond Orbital Model is a physically descriptive model which should prove useful for estimating nonlinear properties of new semiconducting crystal compounds. The accomplishments of this program have been the growth and characterization of the chalcopyrite crystals CdGeAs2, AgGaSe2, and AgGaS2 and their application to the generation of infrared radiation by second, third, and fourth harmonic generation, and by mixing over the spectral range from 1 to 18 mu. (GRA)

25748 (AD-A-007975) IR WINDOW STUDIES. Final Report, 1 Jun 1972-31 Aug 1974. Kroger, F. A.; Marburger, J. H. (University of Southern California, Los Angeles (USA). Electronic Sciences Lab.). 15 Sep 1974. Contract F19628-72-C-0275. 112p. NTIS $5.25.

See also report dated 15 Jun 1974, AD/A-003393.

Topics discussed include Epitaxial growth of semi-insulating GaAs from Ga solutions; Optimization of alkali halide window materials; Growth of crystals for infra red window research; Fabrication of polycrystalline IR window materials; Mechanical behavior of III-V and II-VI compounds; Dielectric constant measurements; Study of defects in II-VI compounds; Theoretical studies of absorption mechanisms in IR window materials; Investigation of infrared loss mechanisms in high resistivity GaAs; Alkali halide surface studies with acoustic probe techniques; Absorption studies of CdTe and ZnSe; Characterization of optical performance of IR window systems; and Laser damage studies. (GRA)

25749 (AD-A-007976) HIGH RADIANCE AlGaAs LASER ILLUMINATOR. Final Report, Jan 1973-Mar 1974. Barratt, W. W.; O'Hara, L. S. (RCA Advanced Technology Labs., Burlington, Mass. (USA)). Nov 1974. Contract F33615-73-C-1204. 72p. NTIS $4.25.

The scope of the program was to conduct research and development of a High Radiance Aluminum Gallium Arsenide (AlGaAs) Laser Illuminator and to fabricate, test and deliver an experimental model of the system developed. This development was aimed at a reduction in the exit aperture, size, and weight of the projection optical system required for a narrow field, high power, liquid nitrogen (LN2) cooled illuminator used in conjunction with gated Low Light Level TV systems. In order to achieve these goals, the development was aimed at producing an improvement in the average brightness of the injection laser array. This was accomplished by reducing the beam divergence from the injection laser diode arrays through use of a microcylindrical lens method. Details of this method, its application to an array and optical integrator assembly and incorporation into an illuminator system are covered. (GRA)

25750 (AD/A-008164) SPECTROSCOPIC AND INFRARED MEASUREMENTS ON CW HF(DF) CHEMICAL LASERS. Interim Report. Kwok, M. A.; Giedt, R. R.; Cross, E. F. (Aerospace Corp., El Segundo, Calif. (USA)). 28 Feb 1975. Contract F04701-74-C-0075. 40p. NTIS $3.75.

The supersonic, free-jet medium of a 10 to 15 kW, HF/DF chemical laser is studied. Results from a remotely controlled spectrograph that scans rapidly, spatially, and spectrally are described; observations from an ir vidicon system are also given. The laser system includes two types of plenum gas heater: arc and combustor; and two types of nozzle bank: split and axisymmetric. The spectrograph measures the HF 3-0 P-branch emission, from which HF(3) number density along the line-of-sight N3L and rotational temperature T(R) are deduced at a large number of spatial positions. The data can be given as three types: (1) spatial scans transverse to the flow, (2) scans parallel to the flow, and (3) data at fixed position. Various interpretations concerning the medium result from the three types of data. (GRA)

25751 (AD/A-008495) SELECTION, SYNTHESIS, GROWTH AND CHARACTERIZATION OF POTENTIAL 10.6 MICRON WINDOW MATERIALS. Final Report, 16 Aug 1971-16 Aug 1974. White, W. B.; Roy, R. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). 15 Dec 1974. Contract F19628-71-C-0232. 24p. NTIS $3.25.

A systematic search has been made for ternary and more complex materials that could serve as new 10.6 mu ir windows. A literature survey of chalcogenide materials allowed the sorting of more than 1000 ternary compounds into structurally-related families. From these were selected the spinel structure, the Th_3P_4 structure, the calcium ferrite structure, and the As–Sb–Bi–Pb–Ag–S system for experimental investigation. On the order of 100 compounds were synthesized and their melting behavior, stability under atmospheric ambients, and vibrational spectra were determined. A systematic investigation of all known alkali halide systems reveals no ternary compounds or combination of binary compounds that appear to be superior to the alkali halide window materials already in use. Complex oxides of bismuth with other metals, most importantly lead, are cubic but have vibrational frequencies too high for their consideration as ir windows. (GRA)

25752 (AD/A-008571) PHOTODISSOCIATION DYE LASER. Semiannual Technical Report, 1 Oct 1974-1 Mar 1975. Kasdan, A. (Exxon Research and Engineering Co., Linden, N. J. (USA). Government Research Lab.). Apr 1975. Contract N00014-73-C-0048. 37p. NTIS $3.75.

The photodissociation dye laser (PDL) program is an effort to develop a new class of tunable liquid lasers operating in the visible region of the spectrum. In the PDL scheme, laser action occurs between an excited electronic state and the ground electronic state of radicals produced by the photodissociation of specific classes of molecules in solution. Five promising PDL molecules have been synthesized and their absorption spectra characterized. A pulsed tunable uv source has been assembled to investigate their fluorescence characteristics. Hexaphenylethane has been identified as the most promising PDL candidate for an initial study. Triphenylmethyl radical fluorescence has been observed in the hexaphenylethane system. (GRA)

25753 (LA-UR-76-368) GENERATION AND AMPLIFICATION OF NANOSECOND DURATION MULTILINE HF LASER PULSES. Getzinger, R. L.; Ware, K. D.; Carpenter, J. P. (Los Alamos Scientific Lab., N. Mex. (USA)). 1976. Contract W-7405-Eng-36. 5p. (CONF-760318-1). Dep. NTIS $3.50.

From meeting of Society of Photo-Optical Instrumentation Engineers; Palos Verdes Estates, California, United States of America (USA) (22 Mar 1976).

High-power, fast-rising pulses of hydrogen fluoride laser energy suitable for laser-fusion target interaction experiments can in principle be generated by directing an electro-optically shuttered oscillator pulse through one or more electron-beam driven amplifiers. A three-stage HF master oscillator-power amplifier (MOPA) configuration was constructed and tested using SF_6–C_2H_6 in which an E-O generated 4-ns-FWHM pulse was amplified in an electron-beam-excited third stage and subsequently isolated with a Brewster angle splitter. Independent experiments in which a 100-ns-FWHM pilot pulse interacted with the power amplifier demonstrated for the first time complete extraction of the available laser energy. These two results provide strong evidence that with upgrading to H_2–F_2, it should be possible to obtain nanosecond duration pulses with power levels sufficient for meaningful laser fusion target coupling experiments.

25754 (SAND-76-5175) HIGH ENERGY HF PULSED LASERS. Patterson, E. L.; Gerber, R. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1976. 7p. (CONF-760306-1). Dep. NTIS $3.50.

From SPIE/SPSE technical symposium; Reston, Virginia, United States of America (USA) (22 Mar 1976).

Recent experiments show that pulsed HF lasers are capable of producing high energy with good efficiency. Preliminary experiments show that the laser radiation from the high-gain medium can be controlled with a low-power probe laser beam or with low-level feedback. These results indicate that the HF laser may have potential for second-generation laser fusion experiments.

25755 (SAND-76-5185) HIGH POWER ATOMIC IODINE PHOTODISSOCIATION LASERS. Palmer, R. E.; Padrick, T.D.; Jones, E. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1976. 9p. (CONF-760306-2). Dep. NTIS $3.50.

From SPIE/SPSE technical symposium; Reston, Virginia, United States of America (USA) (22 Mar 1976).

The atomic iodine photodissociation laser has developed into a system capable of producing nanosecond or shorter pulses of near infrared radiation with energies well in excess of a hundred J. Discussed are the operating characteristics, advantages, and potential problem areas associated with this laser.

25756 MODE LOCKING OF LASER OSCILLATORS BY INJECTION LOCKING. Moses, E.I.; Turner, J.J.; Tang, C.L. (Cornell University, Ithaca, New York 14853). Appl. Phys. Lett. 28: No. 5, 258-260 (1 Mar 1976).

The possibility of mode locking of high-powered laser oscillators by injection locking to a weak mode-locked signal from a cw laser is proposed and demonstrated. The experiment was carried out using a flash-lamp–pumped pulsed dye laser injection locked to a mode-locked cw dye laser. Gains on the order of 3×10^4 and nearly Fourier-transform–limited mode-locked pulses were obtained. (auth)

25757 HIGH-POWER VISIBLE LASER ACTION IN NEUTRAL ATOMIC FLUORINE. Bigio, I.J.; Begley, R.F. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). Appl. Phys. Lett. 28: No. 5, 263-264 (1 Mar 1976).

Atomic fluorine is produced by dissociation of NF_3 in a fast-pulsed electrical discharge in helium. High-power laser action is observed, with 70 kW on five lines near 7100 A, all of which are assigned to electronic transitions in neutral atomic fluorine. Two of the laser lines are reported here for the first time. Some scalability appears possible for this laser, which already has proven to be an excellent pump source for infrared laser dyes. (auth)

25758 GASEOUS SATURABLE ISOLATOR FOR A HIGH-GAIN CO_2 AMPLIFIER CHAIN. Lavigne, P.; Lachambre, J.L.; Gilbert, J. (Centre de Recherches pour la Defense, Defence Research Establishment, Valcartier, Canada). Appl. Phys. Lett. 28: No. 5, 265-267 (1 Mar 1976).

The use of a combination of gaseous N_2F_4 and C_2H_5OH in interstage optical isolators is reported to prevent self-oscillation of a TEA-CO_2 amplifier chain. The results of a preliminary measurement of the absorption and saturation characteristics of N_2F_4 are presented. Single nanosecond pulses of 15 J are stably generated by inserting two such isolators along a 120-dB amplifier chain. (auth)

25759 PICOSECOND UV LASER PULSES FROM GAS DISCHARGES IN PURE NITROGEN AT PRESSURES UP TO 6 ATM. Strohwald, H.; Salzmann, H. (Institut für Plasmaforschung, Universität Stuttgart, 7 Stuttgart 80, Pfaffenwaldring 31, Germany). Appl. Phys. Lett. 28: No. 5, 272-274 (1 Mar 1976).

Single picosecond laser pulses in the second positive band of nitrogen are observed from high-pressure gas discharges with traveling-wave excitation. The gas discharge is operated in pure nitrogen and without preionization. The pulse duration decreases from 300 psec at 1 atm to 50 psec at 6 atm. (auth)

25760 ROOM-TEMPERATURE OPERATION OF GaInAsP/InP DOUBLE-HETEROSTRUCTURE DIODE LASERS EMITTING AT 1.1 μM. Hsieh, J.J. (Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts 02173). Appl. Phys. Lett. 28: No. 5, 283-285 (1 Mar 1976).

Double-heterostructure $Ga_{0.12}In_{0.88}As_{0.23}P_{0.77}$/InP diode lasers emitting at 1.1 μm, with room-temperature pulsed thresholds as low as 2.8 kA/cm^2, have been fabricated by liquid-phase epitaxy on melt-grown InP substrates. (auth)

25761 FAST-DISCHARGE-INITIATED XeF LASER. Wang, C.P.; Mirels, H.; Sutton, D.G.; Suchard, S.N. (The Aerospace Corporation, El Segundo, California 90045). Appl. Phys. Lett. 28: No. 6, 326-328 (15 Mar 1976).

By means of fast-discharge circuitry, intense laser emission was observed from the XeF molecule at 351, 353, and 349 nm in a gas mixture of He, Xe, and NF_3. The over-all electrical efficiency based on the energy deposited in the gas was 1.2%; the "wall-plug" efficiency was 0.2%. An output energy of 1 mJ was measured from a laser pulse 40 nsec in duration, yielding a peak power of 25 kW. A simple model is proposed to estimate the laser performance. (auth)

25762 EFFICIENT HIGH-POWER CH_3F AMPLIFIER FOR A 496-μm CAVITY LASER. Drozdowicz, Z.; Temkin, R.J.; Button, K.J.; Cohn, D.R. (Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Appl. Phys. Lett. 28: No. 6, 328-330 (15 Mar 1976).

A CH_3F amplifier has been constructed for use with a narrow-linewidth pulsed 496-μm CH_3F cavity laser. The power conversion ratio of the amplifier, defined as the ratio of 496-μm power emitted to CO_2 power absorbed, had a maximum value of $(4.7\pm2.5)\times10^{-3}$ at a CH_3F gas pressure of 0.1 Torr. The highest average power, 6 ± 1 kW, was produced by the oscillator-amplifier laser system when the amplifier was run with a CH_3F gas pressure of 0.9 Torr. At this pressure the power conversion ratio of the amplifier was $(1.8\pm1.0)\times10^{-3}$. Analysis of the gain data yields values for the small-signal gain and saturation intensity as a function of CH_3F gas pressure. (auth)

25763 OPTICALLY PUMPED 16-μm CO_2 LASER. Osgood, R.M. Jr. (Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts 02173). Appl. Phys. Lett. 28: No. 6, 342-345 (15 Mar 1976).

A potentially useful 16-μm CO_2 laser, oscillating on the $[10^00,02^00]_{II}$ to 01^10 transition, is described. The $v=1\rightarrow v=0$ lines from an HBr chemical laser were used to pump a low-pressure mixture of HBr and CO_2 gases. Vibrational energy transfer from HBr followed by a 9.6-μm stimulating pulse populated the CO_2 $[10^00,02^00]_{II}$ level. (auth)

25764 LASERS WITH DISTRIBUTED FEEDBACK (REVIEW). Luk'yanov, V.N.; Semenov, A.T.; Shelkov, N.V.; Yakubovich, S.D. Sov. J. Quantum Electron. 5: No. 11, 1293-1307 (Nov 1975).

A review is given of the published literature and the work carried out by the present authors on distributed-feedback lasers, in which optical-frequency electromagnetic oscillations are generated using structures with spatially periodic inhomogeneities (of dimensions comparable with the emission wavelength). Various methods of fabrication of such structures are considered, calculations of the principal physical parameters of distributed-feedback lasers are discussed, and experimental results obtained using various active media and pumping methods are reviewed. Some possible technical applications of such lasers are indicated. Attention is concentrated on thin-film lasers (because more work has been done on them than on other lasers), in which the distributed feedback is achieved by periodic spatial variation of the parameters of an optical waveguide. (auth)

25765 LASER UTILIZING TRANSITIONS BETWEEN LEVELS OF PAIRED CO_2 MODES. Likal'ter, A.A. (Institute of High Temperatures, Academy of Sciences of the USSR). Sov. J. Quantum Electron. 5: No. 11, 1307-1309 (Nov 1975).

The possibility of achieving stimulated emission due to transitions between levels of paired CO_2 modes is considered theoretically. It is shown that the gain for the 03^10–10^00 transition may reach 0.006 cm^{-1} at $T=150°K$ if the CO_2:Ar composition is optimal (1:30) and the degree of ionization is $n_e/n_{CO2}=3\times10^{-7}$. (auth)

25766 CHEMICAL LASERS UTILIZING $N_2F_4+H_2$ AND $N_2F_4+D_2$ MIXTURES INITIATED BY CO_2 LASER RADIATION. Belotserkovets, A.V.; Kirillov, G.A.; Kormer, S.B.; Kochemasov, G.G.; Kuratov, Yu.V.; Mashendzhinov, V.I.; Savin, Yu.V.; Stankeev, E.A.; Urlin, V.D. Sov. J. Quantum Electron. 5: No. 11, 1313-1315 (Nov 1975).

The results are reported of experiments in which stimulated emission was obtained as a result of vibration-rotational transitions in HF and DF molecules in $N_2F_4+H_2$ and $N_2F_4+D_2$ mixtures. The stimulated emission was initiated by CO_2 laser pulses of $\lambda=10.3$–10.6 μ wavelength. The peak output power of the HF laser was 0.5×10^3 W and that of the DF laser was 1.0×10^3 W for pulses of 1.2 and 0.5 μsec duration, respectively. (auth)

25767 USE OF A MULTIBEAM PHASE INTERFEROMETER FOR ACHIEVING SINGLE-FREQUENCY EMISSION FROM LASERS. Troitskii, Yu.V. (Institute of Automation and Electrometry, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. J. Quantum Electron. 5: No. 11, 1331-1335 (Nov 1975).

A description is given of a method for mode selection in a laser resonator. This method is based on establishing between two parts of a light beam a phase shift which is very strongly dependent on the frequency. This phase shift is produced by a multibeam Gires-Tournois reflecting interferometer. Various ways of utilizing this method are discussed. The results of numerical calculations are given for one variant in which multilayer nonabsorbing dielectric coatings are used. It is shown that in this case the selectivity factor of the reflected beam can be of the order of 10^4 or higher. The possibility of constructing a "nonquadratic" selector is considered. The principle of operation (diffraction losses in the undesired modes) of the proposed method resembles the diffraction selector method suggested earlier but it is distinguished by a higher selectivity and a shorter length of the selector. The method may be useful for lasers with a wide gain profile and those exhibiting wavelength hopping. (auth)

25768 INVESTIGATION OF THE ENERGY PARAMETERS OF AN ELECTRON-BEAM-CONTROLLED CO_2 LASER. Basov, N.G.; Danilychev, V.A.; Ionin, A.A.; Kovsh, I.B.; Sobolev, V.A.; Suchkov, A.F.; Urin, B.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 11, 1339-1343 (Nov 1975).

A method was developed for the calculation of the energy parameters of an electron-beam-controlled CO_2 laser. An experimental study was made of the output energy, efficiency, pulse shape, and duration of the radiation emitted by a 10-liter CO_2 laser as a function of the composition of the mixture, electron-beam pump power (pulse duration 1–50 μsec), and electric field in the active medium. The calculation method gave results which were in quantitative agreement with the experimental data. (auth)

25769 CHEMICAL REACTIONS DURING ELECTRIC DISCHARGES IN MOLECULAR GAS LASERS. Bazarov, E.N.; Gerasimov, G.A.; Posudin, Yu.I. (Institute of Radio Engineering and Electronics, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 11, 1351-1354 (Nov 1975).

The results are given of theoretical and experimental investigations of chemical processes occurring during discharges in molecular carbon monoxide and dioxide lasers. The dependences of the final composition of the gas mixture and of the output radiation power of a CO_2 laser on the initial composition of the mixture and the carbon concentration were determined. Several general relationships, characteristic of chemical reactions in such discharges, were established. The experimental results were in agreement with a qualitative calculation based on a "quasi-equilibrium" chemical state model. (auth)

25770 INVESTIGATION OF STIMULATED EMISSION DUE TO TRANSITIONS IN STRONTIUM IN A MIXTURE WITH HYDROGEN. Karabut, E.K.; Kravchenko, V.F.; Mikhalevskii, V.S.; Shelepo, A.P. (Scientific-Research Physics Institute, Rostov-on-Don State University). Sov. J. Quantum Electron. 5: No. 11, 1371-1372 (Nov 1975).

A spectroscopic investigation was made of the excitation and population inversion of strontium ion levels in a mixture with hydrogen excited in a direct-current pulse discharge. The population inversion appeared during the afterglow stage due to recombination of doubly charged strontium ions formed by direct electron impact. The characteristics of the stimulated emission of a mixture of Sr II with H_2 were analyzed. (auth)

25771 NEODYMIUM GLASS LASER EMITTING HIGHLY COHERENT RADIATION. Dukhovnyi, A.M.; Mak, A.A.; Sedov, B.M.; Sokolova, T.V. Sov. J. Quantum Electron. 5: No. 11, 1376-1378 (Nov 1975).

A laboratory prototype was made of a high-power single-mode neodymium glass laser with a narrow emission spectrum and a high degree of spatial coherence. A low-power *Q*-switched (exploding-film) single-mode laser was used as the master oscillator. The first amplification stage consisted of an amplifier with a telescopic resonator. It was demonstrated experimentally that this amplifier was suitable for preamplification of weak signals. The second stage was the usual single-pass amplifier. The operating characteristics of this prototype laser were determined. (auth)

25772 BLEACHABLE FILTER FOR IODINE LASER EMITTING AT $\lambda=1.315$ μ. Gal'pern, M.G.; Gorbachev, V.A.; Katulin, V.A.; Lebedev, O.L.; Luk'yanets, E.A.; Mekhryakova, N.G.; Mizin, V.M.; Nosach, V.Yu.; Petrov, A.L.; Semenovskaya, G.G. (P.N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 11, 1384-1385 (Nov 1975).

A bleachable dye was used in passive *Q* switching of an iodine laser ($\lambda=1.315$ μ). The same dye could be used for optical decoupling of amplifying stages. (auth)

25773 INFLUENCE OF COOLING ON THE OPERATION OF A CHEMICAL CO_2 LASER UTILIZING AN O_2:D_2:CO_2 MIXTURE. Bashkin, A.S.; Oraevskii, A.N.; Tomashov, V.N.; Yuryshev, N.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 11, 1386-1387 (Nov 1975).

A study was made of the influence of the initial temperature of the investigated mixture on the output parameters of the laser such as the pulse duration and shape, and output energy. Measurements were carried out in the temperature range. The influence of the initial temperature depended on the composition and pressure in the mixture and on the *Q* factor of the resonator. (auth)

25774 CONDENSATION OF WATER VAPOR IN A GASDYNAMIC CO_2 LASER. Britan, A.B.; Kortsenshtein, N.M. (Institute of Mechanics, M. V. Lomonosov State University, Moscow). Sov. J. Quantum Electron. 5: No. 11, 1388-1389 (Nov 1975).

A calculation is made of the parameters of a laser mixture flowing out of a planar slit-like nozzle. A system of equations describing the gasdynamics of the flow and the kinetics of the condensation of water vapor from a mixture is solved numerically by the Runge–Kutta method. An estimate is obtained of the influence of condensate droplets on the kinetics of collisional deactivation of the upper laser-active level

of the CO_2 molecule. The results obtained are compared with the experimental values of the gain. (auth)

25775 ELECTRONIC-TO-VIBRATIONAL PUMPED CO_2 LASER OPERATING AT 4.3, 10.6, AND 14.1 μm. Petersen, A.B.; Wittig, C. (Department of Electrical Engineering, University of Southern California, University Park, Los Angeles, California 90007); Leone, S.R. J. Appl. Phys. 47: No. 3, 1051-1054 (Mar 1976).

A pulsed CO_2 laser is described in which the pumping mechanism is electronic-to-vibrational energy transfer from bromine atoms in the $4^2P_{1/2}$ state. Observation of stimulated emission in CO_2 gives detailed information on the specificity of the *E-V* process. The laser operates on the usual 10-μm transitions, as well as two new wavelength regions near 4.3 and 14.1 μm. Pulse energies 112 mJ at 10.6 μm have been obtained by flash photolyzing 80 Torr of a 1 : 1 mixture of Br_2 and CO_2. Extension of this laser system to high-pressure sealed-off operation is discussed. (auth)

25776 LASER OPERATION BY DISSOCIATION OF METAL COMPLEXES: NEW TRANSITIONS IN As, Bi, Ga, Ge, Hg, In, Pb, Sb, AND Tl. Chou, M.S.; Cool, T.A. (School of Applied and Engineering Physics, Cornell University, Ithaca, New York 14853). J. Appl. Phys. 47: No. 3, 1055-1061 (Mar 1976).

New laser transitions at 24 wavelengths from 1.152–12.02 μ have been observed from nine metal atoms. Pulsed discharges have been employed for the production of the metal atoms by dissociation of metal halides, hydrides, and alkyls. This technique shows promise for application for pulsed chemical lasers based on electronic transitions in diatomic metal oxides and halides. (auth)

25777 ELIMINATION OF COMPRESSION WAVES INDUCED BY PUMP LIGHT IN IODINE LASERS. Ishii, S.; Ahlborn, B. (Department of Physics, University of British Columbia, Vancouver, British Columbia, V6T 1W5, Canada). J. Appl. Phys. 47: No. 3, 1076-1078 (Mar 1976).

Photolytical pumping of iodine lasers with flash-light intensities above $W = 1.4 \times 10^5$ W/cm^2 is expected to eliminate shock waves in the lasing gas, which have disturbed recent high-power-iodine-laser experiments. (auth)

25778 EFFECTS OF PROTON BOMBARDMENT ON THE PROPERTIES OF GaAs LASER DIODES. Minden, H.T. (Sperry Research Center, Sudbury, Massachusetts 01776). J. Appl. Phys. 47: No. 3, 1090-1094 (Mar 1976).

Gallium arsenide single-heterostructure lasers were bombarded with protons and annealed. The capacitance and threshold currents were measured. The hole concentration in the active region was calculated from the capacitance. The threshold current increased linearly with decreasing hole concentration over the range investigated. It is postulated that proton bombardment gives rise to damage centers which trap holes. These trapped holes can absorb laser radiation and it is this optical absorption which gives rise to the increased thresholds which are observed in the bombarded lasers. (auth)

25779 PULSE PROPERTIES OF THE TUNABLE DYE LASER PULSE CONVERTER. Chan, C.K.; Sari, S.O.; Foster, R.E. (Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Appl. Phys. 47: No. 3, 1139-1141 (Mar 1976).

Intensity correlation measurements of pulse widths are reported for a sheet-flow rhodamine dye laser mode locked by synchronous gain modulation by a pulsed 2-W argon laser. For pump pulses 1–2-ns long, the minimum dye pulse width obtained is 50 ps. The dye-laser outputs in this pump pulse regime are discussed as a function of cavity length, pump power, and rhodamine and saturable absorber dye concentration. (auth)

25780 SOME REMARKS ON SATURATION OF AMPLIFIED SPONTANEOUS EMISSION. Coisson, R.; Perrone, M.R. (Istituto di Fisica, Università di Lecce, Italy). J. Appl. Phys. 47: No. 3, 1187-1188 (Mar 1976).

Analytical (approximate) solution of rate equations for amplified spontaneous emission in a two-level system, in the case of "fast" pumping, shows the mutual dependence of some parameters characterizing amplification and saturation, such as critical time (or critical length), saturation (or peak) time, and peak power. The spontaneous emission can be accounted for by an equivalent number of initial photons. These results are compared with numerical computer solutions for the N_2 laser. (auth)

25781 EXCITATION MECHANISMS OF THE *e*-BEAM-EXCITED HYDROGEN LASER. Kim, J.J.; Baer, G.; Dexter, R.N. (Department of Physics, University of Wisconsin-Madison, Madison, Wisconsin 53706). Phys. Rev. A 13: No. 3, 1115-1121 (Mar 1976).

We have studied the *e*-beam–excited molecular-hydrogen laser and the effects of foreign gases, preionization, and cooling the gas. The pressure dependence up to 200 Torr of the laser output and the influence of the impurity gas are described in terms of the energy distribution of the plasma electrons produced in the gas breakdown due to the electric field induced by the fast-rising current pulse. Small additions of argon and nitrogen sharply reduce the laser output, unlike helium which has little effect. Preionization of the gas destroys the lasing action which fully recovers in a time of the order of a millisecond. High-repetition-rate three-level laser action should be possible. Magnetic neutralization of the induced electric field or destruction of inversion would both account for the loss of laser action. The optical gain is increased to more than 300% by liquid-nitrogen cooling. The gain depends on the reduction of Doppler broadening by cooling but must also be understood in terms of the thermal redistribution of the rotational populations. Arguments are given in favor of the direct electron excitation of lasing levels in contrast to excitation involving charged intermediate states. (auth)

25782 INFLUENCE OF TRANSIT EFFECTS ON THE FREQUENCY OF A STABILIZED GAS LASER. Titov, E.A. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. J. Quantum Electron. 5: No. 10, 1207-1209 (Oct 1975).

A theoretical analysis is made of the influence of the quadratic Doppler effect, magnetic hyperfine splitting of a line into several components, and transit effects on the emission frequency of a gas laser. This laser is assumed to be stabilized by the frequency modulation method and the modulation frequency is arbitrary. (auth)

25783 CONTINUOUS TUNING OF THE EMISSION FREQUENCY OF ELECTRON-BEAM-PUMPED LASERS. Bogdankevich, O.V.; Borisov, N.A.; Georgobiani, A.N.; Gutan, V.B.; Ilyukhina, Z.I.; Lavrushin, B.M.; Matveev, O.V.; Panesyuk, E.I.; Pevtsov, V.F.; Poletaev, N.L. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 10, 1215-1218 (Oct 1975).

An investigation was made of the possibility of using solid solutions for continuous tuning of the emission frequency of electron-beam-pumped lasers. A method was developed for growing $Zn_xCd_{1-x}Se$ and $Zn_xCd_{1-x}S$ solid solutions and a study was made of their laser characteristics. Continuous tuning of the emission wavelength extending over 270 Å was obtained for $Zn_xCd_{1-x}S$ samples with a composition gradient. The laser action threshold and the output power varied slowly within the tuning range. (auth)

25784 HIGH-PRESSURE ULTRAVIOLET LASER UTILIZING $Ar+N_2$ MIXTURE. Basov, N.G.; Brunin, A.N.; Danilychev, V.A.; Dolgikh, V.A.; Kerimov, O.M.; Lobanov, A.N.; Sagitov, S.I.; Suchkov, A.F. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 10, 1218-1221 (Oct 1975).

An investigation was made of the spectral and energy characteristics of stimulated and spontaneous radiation emitted by an $Ar+N_2$ mixture excited by an electron beam. The maximum specific output power (~ 70 kW/cm^2) was obtained when the pressure in an $Ar:N_2 = 10:1$ mixture was about 8 atm. The efficiency of conversion of the electron-beam energy into the stimulated radiation energy at $\lambda = 357.7$ nm wavelength reached up to $\sim 3\%$. (auth)

25785 CHARACTERISTICS OF THREE-MODE SELF-LOCKED HELIUM-NEON LASER RADIATION. Gelikonov, V.M.; Zaitsev, Yu.I.; Khandokhin, P.A. (Scientific-Research Radiophysics Institute, Gorkii). Sov. J. Quantum Electron. 5: No. 10, 1228-1231 (Oct 1975).

An experimental study was made of several dynamic characteristics of a three-mode helium-neon laser emitting at $\lambda = 0.63$ μ under self-mode-locked conditions. A study was made of the behavior of the intensities of the axial modes and of the total output power under 0 and π mode-locking regimes. This study was carried out both over the whole stimulated emission range and in the frequency intervals corresponding to self-locking. A comparative study was made of the concurrent features in the intensities of the intermodal beats and in the total radiation intensity; a correlation between them was established. A study was made of the behavior of the intermodal beat frequency under 0 and π mode-locking conditions throughout the mode-locked range. (auth)

25786 THEORY OF THE NATURAL WIDTH OF A SEMICONDUCTOR LASER EMISSION LINE. Elesin, V.F.; Rusakov, V.V. (Moscow Engineering-Physics Institute). Sov. J. Quantum Electron. 5: No. 10, 1239-1242 (Oct 1975).

An investigation is made of the dependence of the width of a line emitted by a single-mode semiconductor laser on the intensity of this line. The line width is calculated allowing for the saturation effect. It is shown that saturation results in an additional broadening of the laser line. In a weak field, when the saturation parameter η is small, the product of the line width and the number of photons increases proportionally to the line intensity. In a strong field ($\eta > 1$), this product becomes constant but its value is considerably greater than the value in a weak field. (auth)

25787 THEORY OF A COMPTON LASER. Dubrovskii, V.A.; Lerner, N.B.; Tsikin, B.G. (Scientific-Research Institute of Mechanics and Physics, N. G. Chernyshevskii State University, Saratov). Sov. J. Quantum Electron. 5: No. 10, 1248-1253 (Oct 1975).

An analysis is made of a Compton laser with arbitrary relative orientations of the pump laser beam, electron beam, and resonator. The linear and nonlinear gain, threshold intensity of the pump beam, and output power of a Compton laser are calculated in the semiclassical approximation for conditions approaching reality. The calculation is based on the replacement of the secular Schrödinger equation with a nonsecular equation by adopting a moving coordinate system in which the stimulated scattering can be regarded as the Kapitza–Dirac effect. (auth)

25788 INFLUENCE OF THE LIFETIME OF THE $^4I_{11/2}$ LEVEL of Nd^{3+} ON THE ENERGY CHARACTERISTICS OF A *Q*-SWITCHED LASER. Vitrishchak, I.B.; Soms, L.N. Sov. J. Quantum Electron. 5: No. 10, 1265-1267(Oct 1975).

The rate equations are solved for a *Q*-switched laser allowing for the lower level lifetime. The equations are reduced to dimensionless variables. The results obtained can be used to calculate the energy characteristics of lasers with all possible initial parameters. The special cases of the influence of the lifetime of the lower level $^4I_{11/2}$ and of the initial population inversion on the laser efficiency are considered. (auth)

25789 NEW METHOD FOR THE EXCITATION OF A HOMOGENEOUS DISCHARGE IN A HIGH-PRESSURE CO_2 LASER. Mazurenko, Yu.T.; Rubinov, Yu.A.; Shakhverdov, P.A. Sov. J Quantum Electron. 5: No. 10, 1273-1275 (Oct 1975).

A new method is proposed for the excitation of a homogeneous discharge in a high-pressure gas laser. It is shown that, under the experimental conditions employed, the preionization process is dominated by electrons which are formed in a preliminary discharge and penetrate into the cathode region of the main discharge. An important role is played by the photoionization processes in a "double-discharge" scheme utilizing a preliminary corona discharge. (auth)

25790 SPATIAL COHERENCE OF RADIATION EMITTED FROM INJECTION LASERS. Vvedenskii, B.S.; Logginov, A.S.; Randoshkin, V.V.; Senatorov, K.Ya. (M. V. Lomonosov State University, Moscow). Sov. J. Quantum Electron. 5: No. 10, 1277-1279 (Oct 1975).

An investigation was made of injection lasers with single- and double-sided GaAlAs-GaAs heterojunctions, which were operated in the pulse regime at room temperature. An interferometric method made it possible to determine the spatial correlation functions of the field and intensity of laser radiation. The results demonstrated a relationship between the coherence characteristics and the structure of the emitted transverse modes. These modes were found to have random relative phases. (auth)

25791 SHORTENING OF PULSES EMITTED FROM A MODE-LOCKED RUBY LASER BY DELIBERATE BROADENING OF THE EMISSION SPECTRUM AND REDUCTION OF THE RELAXATION TIME OF A SATURABLE FILTER. Varnavskii, O.P.; Leontovich, A.M.; Mozharovskii, A.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 10, 1280-1281 (Oct 1975).

The emission spectrum of a mode-locked ruby laser was broadened to 5 cm^{-1} by a plane-parallel glass plate. The relaxation time of a saturable filter, which also influenced the pulse duration, was minimized by the use of solutions with a maximum concentration of cryptocyanine. The duration of the pulses emitted under these conditions was measured with an ultrafast saturable-filter optical switch and it was found that the pulse duration was 15 psec, which was 1.5 times shorter than in the case when a dilute cyptocyanine solution was used. (auth)

25792 INFLUENCE OF DISCHARGE FLUCTUATIONS ON THE SPECTRAL STRUCTURE OF INTERMODAL LASER BEATS AT A FREQUENCY *c/2L*. Gus'kov, L.N.; Sologub, V.P.; Troshin, B.I. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. J. Quantum Electron. 5: No. 10, 1282-1283 (Oct 1975).

The results are reported of an experimental investigation of the structure of intermodal beats at a frequency *c/2L* due to two types of fluctuation (relaxation and losses) of the discharge current. (auth)

25793 CORRECTIONS TO "MODULATION OF He-Ne LASER RADIATION BY DISCHARGE CURRENT PERTURBATIONS". Tuchin, V.V.; Akchurin, G.G. (N. G. Chernyshevskii State University, Saratov). Sov. J. Quantum Electron. 5: No. 10, 1288-1289 (Oct 1975).

Modified estimates are given of the modulation characteristics and inertia of the establishment of the electron density in an He-Ne laser. Comments are also made by the authors on their paper. (auth)

25794 EFFECT OF 3.39 μ RADIATION ON THE FREQUENCY CHARACTERISTICS OF A HELIUM-NEON LASER AT 0.63 μ. Borisova, M.S.; Mazan'ko, I.P.; Petrashko, G.A. Sov. Phys.—Tech. Phys. 20: No. 7, 912-916 (July 1975).

In a theoretical and experimental study of a helium-neon ring laser operating on the basis of two simultaneous transitions, $3s_2$–$2p_4$ (λ=0.63 μ) and $3s_2$–$3p_4$ (λ=3.39 μ), it is found that the coupling of these transitions leads to a situation in which the IR generation leads to a significant change in the frequency characteristics of the visible light. In the case of unidirectional lasing at λ=3.39 μ, with a finite frequency difference between the frequency of this radiation and the center of the amplification line, an additional frequency difference arises between the oppositely directed waves with λ=0.63 μ. This difference, which reaches several tens of kilohertz, is found as a function of the laser properties. (auth)

25795 INTERMOLECULAR INTERACTIONS AND THE INDUCED EMISSION SPECTRA OF LIQUID ACTIVATED SYSTEMS. 7: A QUANTITATIVE STUDY OF THE INFLUENCE OF THE TEMPERATURE AND VISCOSITY OF THE SOLVENT ON THE LASING THRESHOLD AND LASING SPECTRA OF SOLUTIONS OF ORGANIC COMPOUNDS. Studenov, V.I.; Bakhshiev, N.G. Opt. Spectrosc. (USSR) 39: No. 4, 371-373 (Oct 1975).

The spectral-luminescent and lasing properties (lasing frequency and lasing threshold) of solutions of 3-amino-*N*-methylphthalimide in *n*-propanol and glycerol and of Rhodamine 6G in isopropyl alcohol have been compared with the energy parameters characterizing intermolecular relaxation processes with variations in the temperature and viscosity of the solution over wide ranges. It has been shown that the regular change in the frequency and threshold intensity of pumping when the solution is cooled is chiefly a consequence of a change in the relative arrangement of the equilibrium and Franck-Condon states of the activator molecule as a result of a change in the state of aggregation of the solvent. (auth)

25796 ANGULAR DIVERGENCE OF AMPLIFIED SPONTANEOUS EMISSION. Rozanov, N.N. Opt. Spectrosc. (USSR) 39: No. 4, 409-412 (Oct 1975).

The angular divergence of amplified spontaneous emission was studied as a function of the gain of the active sample within the framework of linear equations of radiation transfer. The influence of spatial inhomogeneity of the gain and Fresnel reflection from the polished faces of the sample was also studied. The conditions of narrowing of angular divergence along directions with maximum gain at high amplifications and in inhomogeneous pumping were determined, and a significant increase in angular divergence allowing for reflections from the polished faces was found. (auth)

25797 POLARIZATION OF LASER RADIATION FROM ORGANIC DYE SOLUTIONS. Yaroshenko, O.I.; Rudik, E.I.; Pikulik, L.G.; Maksimov, A.I. Opt. Spectrosc. (USSR) 39: No. 4, 421-423 (Oct 1975).

The paper is devoted to model calculations of the degree of polarization of laser radiation from organic dye solutions when the laser is excited by linearly polarized light. The anisotropy and peaking character of the gain are prescribed as the basis of calculation. The main reasons for 100% polarization of the lasing radiation are explained. The depolarizing effect of Brownian rotations of the active molecules is included. Corresponding calculations agree qualitatively with experiment. (auth)

25798 THE CONVERSION OF HIGH-POWER, GIANT-PULSE LASER RADIATION INTO THE SECOND AND FOURTH HARMONICS. Ershov, L.S.; Zalesskii, V.Y.; Sokolov, V.N. Sov. J. Opt. Technol. 42: No. 8, 433-434 (Aug 1975).

A scheme is described that consists of a neodymium-activated glass, giant-pulse laser with a pulse energy of 20–30 J and subsequent conversion of the radiation frequency into the second and fourth harmonics. The fourth harmonic radiation energy amounted to 1.5 J. Further increase in the laser energy and, accordingly, the energy of the converted radiation is limited by the optical strength of the elements. (auth)

25799 A LASER WITH A ONE-STAGE AMPLIFIER, PROVIDING CONTINUOUS ADJUSTMENT OF THE RADIATION WAVELENGTH IN THE 400–1000 NM REGION. Bonch-Bruevich, A.M.; Razumova, T.K.; Starobogatov, I.O. Sov. J. Opt. Technol. 42: No. 9, 516-519 (Sept 1975).

The design and construction of a giant-pulse laser with a one-stage amplifier employing organic dye solutions with continuous adjustment of the radiation wavelength in the 400–1000 nm region are described. The parameters of the radiation are given. (auth)

25800 NOISES IN CO_2 LASERS. Taklaya, A. A. (Tallin Polytechnic Inst., USSR). Tr. Tallin. Politekh. Inst.; No. 358, 49-52 (1974). (In Russian).

An experimental investigation was made of the spectrum and probable density distribution of noises from two CO_2 lasers (continuous operation) in the 10.6 μ band. The lasers had plane-spherical resonators 0.56 and 0.86 m in length. The resonator of the first laser (OKG-15) was made of aluminium and the second of Invar. A similarity was shown in the characteristics of the lasers according to the spectrum of lf noises (width of spectrum about 14 kHz), probablity density distribution of the noises (normal law), and influence of vibrations on the output emission. Stability of power of output emission from the lasers is substantially different and higher in the laser with more stable (Invar) resonator:

the fluctuations in the second have a mean square value of about 10^{-3} and in the first about 10^{-2}. (Ref. Zh.)

25801 CHANGE IN THE SPECTRUM OF A TWO-FREQUENCY HELIUM-NEON LASER ACTED ON BY A LIGHT SIGNAL. Vorobeychikov, E. S.; Vokhmin, V. A.; Larin, V. L.; Perkal'skis, B. Sh.; Poyzner, B. N. (Tomsk Univ., USSR). Tr. Sib. Fiz.-Tekh. Inst. Tomsk. Gos. Univ.; No. 54, 11-16(1974). (In Russian).

An investigation was made into the change in spectrum of oscillation of a two-frequency He-Ne laser (633 nm) acted on by a coherent signal from another He-Ne laser, the frequency of which is tuned to one of the two frequencies of the investigated laser. The transition from 2-frequency oscillation to 1-frequency oscillation is caused by the trapping of one of the frequencies by an external coherent signal. (Ref. Zh.)

25802 METAL ATOM OXIDATION LASER. Jensen, R. J.; Rice, W. W.; Beattie, W. H. (to U.S. Energy Research and Development Administration). US Patent 3,916,338. H01S3/22; H01S3/095. 28 Oct 1975. Filed date 13 May 1974. 8p.

PAT-APPL-469,737.

A chemical laser which operates by formation of metal or carbon atoms and reaction of such atoms with a gaseous oxidizer in an optical resonant cavity is described. The lasing species are diatomic or polyatomic in nature and are readily produced by exchange or other abstraction reactions between the metal or carbon atoms and the oxidizer. The lasing molecules may be metal or carbon monohalides or monoxides.

25803 HIGH ENERGY CHEMICAL LASER SYSTEM. Gregg, D. W.; Pearson, R. K. (to U.S. Energy Research and Development Administration). US Patent 3,928,821. H01S3/22. 23 Dec 1975. Filed date 23 Jan 1975. 8p.

PAT-APPL-543,611.

A high energy chemical laser system is described wherein explosive gaseous mixtures of a reducing agent providing hydrogen isotopes and interhalogen compounds are uniformly ignited by means of an electrical discharge, flash-photolysis or an electron beam. The resulting chemical explosion pumps a lasing chemical species, hydrogen fluoride or deuterium fluoride which is formed in the chemical reaction. The generated lasing pulse has light frequencies in the 3-micron range. Suitable interhalogen compounds include bromine trifluoride (BrF_3), bromine pentafluoride (BrF_5), chlorine monofluoride (ClF), chlorine trifluoride (ClF_3), chlorine pentafluoride (ClF_5), iodine pentafluoride (IF_5), and iodine heptafluoride (IF_7); and suitable reducing agents include hydrogen (H_2), hydrocarbons such as methane (CH_4), deuterium (D_2), and diborane (B_2H_6), as well as combinations of the gaseous compound and/or molecular mixtures of the reducing agent.

25804 GENERATION OF LASER RADIATION WITH TWO-FREQUENCY MODULATION OF THE LOSS LEVEL. Tsikunov, V. N. Dokl. Akad. Nauk SSSR; 223: No. 2, 328-331(11 Jul 1975). (In Russian).

This study investigates the behavior of a solid laser system under conditions where the loss level is varied by the action of two harmonic perturbations of different frequency. An equation is presented that describes the change with time in the number of photons N in a resonator under conditions of a change in loss level $\gamma = \gamma_0 + \Delta\gamma(t)$. The loss level is a function of the amplitude and frequency of the two harmonic modulations. It is shown that as a result of a shift in the resonance region the modulation of the frequency ω_2 applied from the outside may have a substantial effect on uncontrollable time loss changes existing in the laser. By using lasers having a forced periodic modulation of the quality factor Q it is possible to suppress the effects of various, parasitic, periodic changes in loss level, which occur during generation because of vibration of the mirrors and medium, changes in position of the dielectric boundaries in the resonator and changes in light scattering within the sample. It can be said that forced modulation can change within wide limits the sensitivity of laser system to harmonic perturbations of another frequency. (SJR)

25805 FORCED AND FREE CONVECTION TURBULENT BOUNDARY LAYERS IN GAS LASERS. Woodroffe, J. A. (Avco Everett Research Lab., Inc., Everett, MA). AIAA (Am. Inst. Aeronaut. Astronaut.) J.; 13: No. 7, 942-944(Jul 1975).

Approximate expressions for the effect on optical path length through a turbulent vertical boundary layer caused by the combined presence of forced and free convection were obtained to first order in the asymptotic cases of dominant forced convection and dominant free convection. The effect in both cases is a reduction of the boundary-layer thickness. Characteristic scaling lengths are presented which aid in the optical analysis of the flowfield. (auth)

25806 SPECTRAL ENHANCEMENT OF NEAR UV XENON FLASHLAMPS. Gusinow, M. A. (Sandia Labs., Albuquerque, NM). Appl. Opt.; 14: No. 11, 2645-2649(Nov 1975).

The addition of certain elements to xenon flashlamps can result in a factor of 2 to 3 enhancement of the emitted energy in the 2500 to 3000 A spectral range. The degree of enhancement is dependent on the dopant and discharge current. (auth)

25807 FUNDAMENTAL ABSORPTION EDGE IN LASER WINDOW CdTe. Nurmikko, A. V. (Brown Univ., Providence, RI). Appl. Opt.; 14: No. 11, 2662-2664(Nov 1975).

Fundamental absorption edge and the ir absorption at 10.6-mu m wavelengths were studied in CdTe laser window samples of varying optical quality. The results showed that the edge spectroscopy can be used as a sensitive diagnostic technique for evaluating the overall optical quality of the material. (auth)

25808 ISOTOPIC AND CHEMICAL EFFECTS IN MOLECULAR LASERS. Capitini, R.; Ceccaldi, M.; Garnier, J. P.; Goujon, P.; Leicknam, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Section des Recherches et de l'Interaction du Rayonnement avec la Matiere). Bull. Inf. Sci. Tech. (Paris); No. 205, 43-55(Jul 1975). (In French).

Studies have been made of carbon dioxide molecular lasers enriched with ^{18}O and ^{13}C isotopes. The results obtained with the emission of $^{12}CO_2$, $^{13}CO_2$ and $^{12}CO_2$, $^{12}C^{16}O$ and $C^{18}O_2$ mixtures reveal a total isotopic effect in accordance with gaseous mixture concentrations. This phenomenon is discussed and interpreted by means of a theoretical model. The extension of these observations to non-isotopic molecules is shown. The practical attraction of these emissions is examined.

25809 SOME PROPERTIES OF $Al_xGa_{1-x}As$ SOLID SOLUTION HETEROLASERS FOR THE VISIBLE REGION. Druzhinia, L. V.; Dolginov, L. M.; Eliseev, P. G.; Ismailov, I.; Shokhudzhaev, N. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk Tadzh. SSR; 18: No. 4, 23-24(1975). (In Russian).

The radiation characteristics of lasers with a two-sided heterostructure, prepared by the method of liquid epitaxy, were measured at 77 and 300°K. The results obtained are tabulated and shown graphically. (JSR)

25810 PLASMA AND KINETIC MODELING OF MAGNETICALLY CONFINED NOBLE GAS ION LASERS. Tio, T. K. San Diego, CA; Univ. of California (1975). 291p. University Microfilms Order No. 75-29,465.

Thesis (Ph. D.).

The basic plasma and kinetic processes operative in a magnetically confined cw noble gas ion laser are investigated, and a general theory is developed. The interaction between the radiation field and the active gain medium is treated in the rate equation approximation. The gross discharge plasma properties are the same in either lase or nonlase conditions, allowing the decoupling of the discharge plasmadynamics from the laser kinetics. Both simple and complex models are given to describe the excitation/de-excitation and inversion mechanisms. Good agreement between theory and experiment suggests that the plasma and kinetic models employed here are basically sound. (TFD)

25811 OPTIMIZATION AND LIMITING CHARACTERISTICS OF CARBON DIOXIDE LASERS. Ponomarenko, A. G.; Soloukhin, R. I.; Tishchenko, V. N. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 120-131(1975). (In Russian).

It is shown that the limiting characteristics of CO_2-lasers are determined mainly by two parameters: the ratio of the specific power of the electric discharge to the square of the pressure of the active medium M/p^2, and the product of the pumping time by the gas pressure tp. A study was made of the dependence of the efficiency and pulse form of the radiation over a wide range of these parameters. First, it is noted that the energy from a lower laser level can be drawn off to higher oscillatory states of symmetrical and deformation modes, by means of which it is possible, as computer calculations show, to realize high radiation densities of ~ 0.2 J/cm^3·atm. Because of a redistribution of energy in the asymmetrical mode the limiting coefficient of amplification in CO_2-lasers is ~ 0.12 cm^{-1}. (SJR)

25812 QUANTUM THEORY OF A SWEPT-GAIN LASER AMPLIFIER. Hopf, F. A.; Meystre, P. (Univ. of Arizona, Tucson). Phys. Rev., A; 12: No. 6, 2534-2548(Dec 1975).

The buildup of radiation from noise is considered in the case of the small-signal regime of a swept-gain amplifier with small Doppler width, of the sort indicated in recent schemes for an x-ray laser. The treatment uses the fully quantized electromagnetic field in order to take into account the spontaneous emission. The pulse is seen to grow nonexponentially with a rate that vanishes in the limit of large distances. The gain is generally much smaller than would be expected on the basis of the usual development. Many of the features normally associated with the small-signal regime of an amplifier, such as threshold conditions and spectral narrowing, are not seen. Instead we find spectral broadening, saturation, and the formation of steady states. (auth)

25813 STEADY-STATE PULSES AND SUPERRADIANCE IN SHORT-WAVELENGTH, SWEPT-GAIN AMPLIFIERS. Bonifacio, R.; Hopf, F. A.; Meystre, P.; Scully, M. O. (Univ. of Arizona, Tucson). Phys. Rev., A; 12: No. 6, 2568-2573(Dec 1975).

The steady-state behavior of amplifiers in which the excitation is swept at the speed of light is discussed in the semiclassical approximation. In the present work the case where the decay time of the population is comparable to that of the polarization is examined. Pulse propagation is shown to obey a generalized sine-Gordon equation which contains the effects of atomic relaxations. The analytical expression of the steady-state pulses (SSP) gives two threshold conditions. In the region of limited gain the SSP is a broad pulse with small area which can be obtained by small signal theory. In the second region of high gain the SSP is the superradiant pi pulse. Its pulse power is not limited as in usual superradiant theory because, as is shown, for a swept excitation the cooperation-length limit does not exist. (auth)

25814 TILTED BIREFRINGENT FABRY–PEROT ETALON FOR TUNING DYE LASERS. Okada, M.; Takizawa, K.; Leiri, S. (Broadcasting Science Research Labs., Tokyo). Appl. Opt.; 15: No. 2, 472-476(Feb 1976).

A tilted birefringent Fabry–Perot etalon, which is set at an angle to the axis of the dye laser cavity and rotated about the normal of end-faces of the etalon, allows the dye laser emission to be tuned with very high finesse as obtained by two cascaded conventional Fabry–Perot etalons.

25815 HIGH POWER OPTICALLY PUMPED FAR INFRARED LASER SOURCES. Plant, T. K. Urbana, IL; Univ. of Illinois (1975). 120p. University Microfilms Order No. 76-6907.

Thesis (Ph. D.).

An optically pumped methyl fluoride (CH_3F) laser with a very slowly diverging spatially and temporally smooth beam and producing 20 percent of the Manley-Rowe limit is analyzed. A well moded cw optically pumped FIR waveguide laser is the local oscillator and is amplified in a single pass cell from 1 to 3 m long by a CO_2 TEA laser pump. An output of approximately 0.2 mJ 496 mu m radiation is obtained for a CO_2 input of approximately 80 mJ and the FIR beam follows the smooth, single moded TEA laser pulse in space and time. A simple one mirror feedback system and a waveguide cavity are also examined. The one mirror feedback with no local oscillator required is shown to produce the highest power and most efficiency and is suggested as a plasma diagnostic tool. A theoretical rate-equation model is presented which is in excellent agreement with experiment. The most recent optical constants for CH_3F are also presented. A scaling calculation shows that a 1 MW smooth (spatially and temporally) FIR pulse is possible using a CO_2 pump energy less than 15 J in a cell 3 m long by 15 cm in dia.

25816 DEFORMATION OF CERAMIC MATERIALS. Proceedings of a Symposium Held in University Park, Pennsylvania, July 17, 18, and 19, 1974. Bradt, R. C.; Tressler, R. E. (Eds.). New York Plenum Press (1975). 586p. (CONF-740724-). $45.00.

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974).

Thirty-one papers were presented at the conference. A separate abstract was prepared for 7 papers for NSA. In addition, 2 papers were abstracted for ERA. Five papers have previously appeared in NSA. For abstracts of these see 30: 24483, 30: 27341, 31: 06461, 31: 21945, and 32: 17684. The remaining papers were not in scope for either journal. (RCK)

For abstracts of individual papers see: 25817–25820 and 26500–26502.

25817 HOT WORKING ALKALI HALIDES FOR LASER WINDOW APPLICATIONS. Koepke, B. G.; Anderson, R. H.; Stokes, R. J. (Honeywell Corporate Research Center, Bloomington, MI). pp 497-516 of Deformation of Ceramic Materials. Bradt, R. C.; Tressler, R. E. (Eds.). New York; Plenum Press (1975).

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974). See CONF-740724-.

The techniques used to hot work alkali halide crystals into laser window blanks are reviewed. From the point of view of high power laser window applications one of the materials with a high figure of merit is KCl. Thus the materials examined are KCl and alloys of KCl-KBr containing 5 mole percent KBr. The fabrication techniques include conventional and constrained press forging, isostatic press forging and hot rolling. Optical properties are paramount to the ultimate usefulness of these materials. Results on the optical properties of the hot worked material are included together with mechanical properties and microstructural data. (TFD)

25818 PRESS FORGING BEHAVIOR OF KCl CRYSTALS AND RESULTANT STRENGTHENING. Becher, P. F.; Rice, R. W.; Klein, P. H.; Freiman, S. W. (Naval Research Lab., Washington, DC). pp 517-530 of Deformation of Ceramic Materials. Bradt, R. C.; Tressler, R. E. (Eds.). New York; Plenum Press (1975).

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974). See CONF-740724-.

The use of alkali halides for optical components of laser systems has been limited by the fact that single crystals deform and fracture at low stresses. The press forging of pure and Sr doped KCl single crystals with regard to microstructural development and consequent yield strength and fracture toughness is examined. (TFD)

25819 PRESS FORGING OF SINGLE CRYSTAL CALCIUM FLUORIDE. Turk, R. R. (Hughes Research Labs., Malibu, CA). pp 531-548 of Deformation of Ceramic Materials. Bradt, R. C.; Tressler, R. E. (Eds.). New York; Plenum Press (1975).

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974). See CONF-740724-.

Single crystals of high-purity calcium fluoride have been deformed uniaxially in an attempt to improve strength and resistance to cleavage, without impairing infrared transmission. Order of magnitude increases in strength, such as those found in forged KCl, have not been attained, but fine-grained polycrystalline material has been produced which is resistant to crystalline cleavage. Deformation rates of 10^{-2} min^{-1}, reductions of 10 to 73 percent in height, and deformation temperatures of 550 to 1000°C have been used. Flexural strengths over 13,000 psi and grain sizes down to 5 mu m have been obtained. Reduction of residual stress through heat treatment has been studied, and resultant techniques applied before, during, and after deformation. No increase in infrared absorption has been noted at the CO laser wavelength of 5.3 mu m. (auth)

25820 GRAIN BOUNDARIES AND GRAIN BOUNDARY MOBILITY IN HOT-FORGED ALKALI HALIDES. Yan, M. F.; Cannon, R. M.; Bowen, H. K.; Coble, R. L. (Massachusetts Inst. of Tech., Cambridge). pp 549-569 of Deformation of Ceramic Materials. Bradt, R. C.; Tressler, R. E. (Eds.). New York; Plenum Press (1975).

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974). See CONF-740724-.

Recent interest in alkali halide crystals as infrared windows for high power lasers has led to the development of high temperature deformation processing of halide single crystals to improve their mechanical properties. The substructure formation and subsequent motion of boundaries in hot-forged KCl are elucidated. (TFD)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 25732, 26923, 26927, and 26929.

25821 (ORNL/TM-5210) CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS. Quarterly Report, April 1–June 30, 1975. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 85p. Dep. NTIS $6.00.

During this reporting period, April 1 to June 30, 1975, ac dielectric breakdown and partial discharge measurements were carried out on several new polyolefin films immersed in liquid helium at atmospheric pressure. The average breakdown strengths ranged from 135 to 220 MV/m, and were close to the breakdown strengths for the other materials already tested. Analysis of the partial discharge inception voltages for all of the materials tested so far shows that the major determinant of partial discharge inception is the breakdown voltage of the helium layer in series with the film. In other experiments on Valeron polyethylene with both film and electrodes completely encapsulated by epoxy, breakdown occurred with no observable partial discharge. The partial discharge sensitivity was the same as used for the unencapsulated film experiments. The breakdown strength with encapsulation was slightly higher than without. The temperature was varied from 4.2 to 300°K, but no influence on the breakdown strength was observed. Breakdown tests with ac voltage were carried out on liquid helium between ASTM electrodes. The peak breakdown voltages measured on the first run were somewhat lower than the previously measured dc voltages. After repolishing the electrodes, another run in which both dc and ac breakdown voltages were taken showed good agreement. However, the voltages were now about 30 percent higher than those of the first run, and were close to the ASTM standard for C-10 oil. It is suspected that contamination in the helium is responsible for the variable results. (auth)

25822 SUPERCONDUCTIVE COMMUNICATIONS CABLE. Hoshiko, Y.; Chiba, N. (Japanese Telegraph Telephone Co., Tokyo). Oyo Butsuri; 40: No. 8, 905-906(Aug 1971). (In Japanese).

The economics of communication using a superconductive coaxial cable is reviewed. The general performance of the cable is discussed and a graph of the time domain characteristics against the reflection coefficient (P) for normal coaxial (Nb-Pb) cable and precision built (Pb-Pb) coaxial cable at 4.2° K is given. The coefficient is much more constant with distance for the (Pb-Pb) cable. The Nb-Pb cable costs about five times per unit length more than the Pb-Pb. Next the cooling system is dealt with, which comprises concentric layers of liquid He, super-insulation, liquid N_2 and vacuum.

25823 SUPERCONDUCTIVITY AND ITS APPLICATIONS TO POWER ENGINEERING. Hadlow, M. E. G.; Lindley, B. C. IEE (Inst. Electr. Eng.) Rev.; 119: No. 8R, 1003-1032(Aug 1972).

The review paper traces the history of superconductivity from its discovery in 1911 to the more recent developments of superconductors that are potentially useful in practical applications. The present state of knowledge of the theory of superconduction is presented in sufficient detail to gain an understanding of the phenomenon and the characteristics that will be important to the engineer. The state of development of a range of actual and potential applications of superconductors is assessed in terms of research magnets, electrical machines, cables, transformers, magnetic suspension, energy storage and others. It is concluded that, while the range of applications likely to be realized in commercial practice is perhaps less than that being advocated a few years ago, certain areas of development of large-scale electrical-engineering equipment employing superconductors will attract increasing interest and effort in the future.

25824 POWER TRANSMISSION LINES IN FUTURE. Mitkowski, E.; Janiszewski, A. (Politechnika Poznanska, Poland). Energetyka; 27: No. 6, 182-187(Jun 1973). (In Polish).

An analysis of the technical and economic power transmission possibilities by means of ac or dc EHV lines, cryogenic cables and waveguides is presented.

25825 LOSSES IN SUPERCONDUCTING COAXIAL TRANSMISSION LINES. Voges, E.; Petermann, K. (Technische Univ., Braunschweig, Ger.). Arch. Elek. Uebertrag.; 27: No. 9, 384-388(Sep 1973).

The conduction losses are calculated using the BCS surface impedance of a superconductor and are compared with classical solutions. Numerical results are given for niobium and lead for frequencies up to 200 GHz and temperatures between 4.2°K and the critical temperature T_c. The calculations result in a frequency dependence of the conduction losses for frequencies F < 10 GHz with surface resistances of 3×10^{-7} omega and 6×10^{-7} omega for niobium and lead at T = 4.2°K and F = 1 GHz and show a nearly exponential temperature dependence. For frequencies lower than about 1 GHz the dielectric losses exceed the conduction losses at T = 4.2°K for a tan $\delta > 10^{-6}$.

25826 DEVELOPMENT OF CRYOGENIC CABLE. Fukasawa, M.; Kuma, S.; Sugiyama, K.; Koishihara, S.; Nagano, H. (Hitachi Cable Ltd., Tokyo). Hitachi Hyoron; 22: No. 10, 430-434(1973).

With a trially manufactured liquid-nitrogen cryogenic cable and a forced cooling system, a simulated test on an actual transmission line was carried out. The testing line, with a 66 kV rated voltage, consisted of a 1×100 mm^2 cable, 30 m long, with a liquid-nitrogen pressurized system. The line was operated with stability over a long period, under a 38 kV (1.0E) voltage and 1000 A (10 A/mm^2) current rating. Preliminary test results concerning electrical insulation, thermal insulation, coolant circulation system at liquid-nitrogen temperature were proved to be applicable to practical cables. For electrical insulation, liquid-nitrogen- impregnated polyethylene fiber was used. For thermal insulation of the pipeline, polyurethane foam was employed in view of heat generation in the pipeline.

25827 JOSEPHSON JUNCTION TRANSMISSION LINES. Barone, A.; Permentier, R. D. (CNR, Naples). Alta Freq.; 40: No. 2, 166-168(Feb 1971).

Josephson tunnel junctions as active strip transmission lines are considered. Pulse propagation analysis, bias current requirements, lumped structures, and fabrication technology are discussed.

25828 ENERGY TRANSPORT THROUGH CRYOGENIC CABLE. Bogner, G.; Schmidt, F. Naturwissenschaften; 57: No. 9, 414-422(Sep 1970). (In German).

The properties of the basic components of cryogenic cables, such as conducting materials, thermal and electrical insulation, and cooling requirements, are described. Some of the most important concepts of superconducting and hydrogen- or nitrogen-cooled normal metal cables are introduced. A rough technical and economic comparison of cable types so far proposed shows that cryogenic cables become attractive only at power rates above 1000 MVA; this is especially true of superconducting ac cables.

25829 SUPERCONDUCTING POWER TRANSMISSION. Meyerhoff, R. W. (Union Carbide Corp., Tarrytown, NY). Cryogenics; 11: No. 2, 91-101(Apr 1971).

The case for and the development of superconducting power lines are presented. After a brief history of superconducting power transmission, studies at present being undertaken in various countries throughout the world are discussed. A final resume outlines problems still to be tackled before superconducting power lines can be put into operation.

25830 TEMPERATURE DEPENDENCE OF AC LOSSES IN SUPERCONDUCTING NIOBIUM. Rogers, E. C.; Redmonds, B. E.; Chan, G. D. (British Insulated Callenders Cables Ltd., London). Cryogenics; 9: No. 6, 431-437(Dec 1969).

A method is described for measuring the ac losses in superconducting niobium strip as a function of temperature. The design principles, the experimental procedure, and the means adopted for reducing various sources of error are discussed. The measured losses depend on the method of preparing the sample edges and are at least when the edges are folded. Results are given for the 50 Hz loss per unit area in a sample of 25 MUm thick niobium strip with folded edges.

25831 CRYOGENIC POWER TRANSMISSION. Minnich, S. R.; Fox, G. R. Cryogenics; 9: No. 3, 165-176(Jun 1969).

The capabilities and outlook for cryogenic power transmission are reviewed. A comparison of cooled normal conductor and superconductor systems is given. It is concluded that, for very large powers, cryogenic systems may be competitive.

25832 VERY HIGH POWER TRANSMISSION OVER LARGE DISTANCES WITH THE AID OF MICROWAVES AND SUPRACONDUCTIVE LINES. Paul, H. Int. Elektron. Rundsch.; 24: No. 4, 87-90(Apr 1970). (In German).

The increasing demand for energy and length of lines in conventional engineering result in extremely high transmission voltages. It is shown that overdimensioned circular microwave waveguides could just as well be used as far as line loss and capacitance are concerned. In relation to the mode transformation resulting in additional loss, this disadvantage can be avoided. A power supply network using microwave lines is suggested. After a discussion of the supraconductive dc cable and of the difficulties involved in cooling, the cost of transmission caused by each of four different systems is compared.

25833 MEASUREMENT OF 50 Hz DISSIPATION IN SUPERCONDUCTING NIOBIUM STRIPS. Grigsby, R.; Slaughter, R. J. (British Insulated Callenders Cables Ltd., London). J. Phys., D (London); 3: No. 6, 898-905(Jun 1970).

Measurements of ac losses in superconducting niobium strips by the helium boil-off method were made with a view to assessing the effects of sample thickness, surface finish and metallurgical hardness on prospective superconducting cable conductor materials. The method of preparing the strip edges was shown to have considerable effect upon the level of measured losses. The measurement technique is described in some detail.

25834 SUPERCONDUCTIVE UNDERGROUND ELECTRIC TRANSMISSION: ONE STEP CLOSER. Cryog. Ind. Gases; 4: No. 7, 22-24(Jul 1969).

At a press conference in New York, a superconducting cable concept-deposition of high purity niobium on a tabular metal backing by a proprietary molten salt electroplating process was discussed. Earlier research established ultra-pure niobium as an excellent ac superconductor, producing acceptable, minimal ac losses. One pipe with a diameter less than 20 in. could handle up to 10,000 MVA at kV voltages.

25835 APPLICATION OF SUPERCONDUCTING MATERIALS AS SWITCHES IN ELECTRIC POWER TRANSMISSION. Heller, I. (Technische Hoshschule, Aachen). Elektrotechniek; 49E: No. 22, 1011-1014(28 Oct 1971). (In German).

A general discussion of the principles and practical and economic aspects is followed by a theoretical consideration of the possibilities of superconducting switches in HVDC transmission. A summary is given of an experimental investigation of the switching speed of superconducting switching elements.

25836 ELECTRICAL CHARACTERISTICS OF SUPERCONDUCTING CABLE. Ito, N. Denki Shikensho Iho; 35: No. 2, 161-171(1971). (In Japanese).

25837 AC LOSS AND FLUX INSTABILITIES IN SINGLE-COMPONENT AND DOUBLE-COMPONENT TYPE II SUPERCONDUCTORS. Melville, P. H. (Central Electricity Research Labs., Leatherhead, Eng.). J. Phys., D (London); 5: No. 3, 613-627(Mar 1972).

Calculations are presented for ac loss and flux instabilities under ac and dc conditions in Type II superconductors in fields that are greater than H_{c1} but not so large that surface currents, the annihilation energy of fluxons and other effects associated with H_{c1}, can be neglected. The calculations are particularly relevant to the design of ac power transmission cables and attention is paid to a two-component superconductor (e.g., a Nb/high-field superconductor) under fault conditions; that is, with current flowing in both the niobium and the high-field superconductor. In general, inclusion of surface currents and other effects associated with a finite value of H_{c1} leads to a decrease in the ac loss and a decrease in the probability of flux jumping. It also shows that the energy of annihilation of fluxons is only important for flux jumping when the peak field is less than about $2H_{c1}$. It is the stored energy in the flux distributions that gives more flux jumping with ac than with dc. In the two-component superconductor an abrupt change in flux occurs when the flux density at the boundary between the two materials falls to zero. This gives larger losses than the equivalent superconductor without the niobium layer and makes flux jumping more likely.

25838 SUPERCONDUCTIVITY: APPLICATIONS IN ELECTRICAL MACHINES. Wejle, S. Tek. Tidskr.; 102: No. 2, 12-15(4 Feb 1972). (In Swedish).

Data on superconductor materials are reviewed and their advantages, e.g., for MHD band plasma generators are reviewed. Some technical and economic problems arising in certain applications (cooling water pump at Fawley, ac synchronous machines, experimental work on power transmission cables) are described. Aircraft applications would be particularly beneficial owing to importance of weight saving (estimated saving for Concorde 6000 sw.kr/year).

25839 PROSPECTS FOR FUTURE POWER TRANSMISSION: THE 38TH CONFERENCE OF THE SFH IN MANNHEIM. Blaschke, H. (VDEW, Frankfurt a Main). Elektrizitaetswirtschaft; 71: No. 4, 106-112(14 Feb 1972). (In German).

The 38th conference of the study association for high voltage installations (SFH) had as its subject the problems in power transmission at voltages over 1000 kV. Questions were listed which will require attention in the further work of the SFH. In order to reduce the very large insulation gaps at these voltages it will be necessary to go over to SF_6 instead of air as the insulant, i.e., to enclosed installations. In the cable area, the requirement to transmit greater powers in the same line space into the population centers makes new methods necessary, e.g., cryogenic cables or supercooled conductors.

25840 SUPERCONDUCTORS FOR POWER ENGINEERING: TODAY OR TOMORROW. Norris, W. T. Stud. Q. J., Inst. Electr. Eng.; 47: No. 162, 188-191(Dec 1970).

In the basic theory of superconductivity, quantum mechanics is essential, and even then the theory is incapable of accurate quantitative predictions. This article deals only with electric-power applications, and leaves aside both the atomic theory and electronics applications, such as Josephson junctions.

25841 NANOSECOND PULSE TRANSMISSION THROUGH SUPERCONDUCTING COAXIAL CABLE. Borodovskii, V. S.; Gal'perovich, D. Ya. 26-27: No. 11, 91-94(Nov 1972).

Experimental data on the attenuation of a superconducting cable are used to calculate its transient characteristics. The experimental method and results are described.

25842 DEVELOPMENT OF CRYOGENIC CABLE. Fukasawa, M.; Kuma, S.; Sugiyama, K.; Koishighara, S.; Nagano, H. Hitachi Hyoron; 22: No. 10, 430-434(1973).

A simulated test on an actual transmission line was conducted using a prototype liquid-nitrogen cryogenic cable and a forced cooling system. The 66 kV rated line consisted of a 1×100 mm^2 cable, 30 m long, with a liquid-nitrogen pressure circulation system. The line was operated over a long period in a stable condition with 38 kV and 1.000 Amp. Preliminary test results concerning electrical insulation, thermal insulation, coolant circulation system at liquid-nitrogen temperature were proved to be applicable to practical cables. Liquid-nitrogen-impregnated polyethylene fiber was used for electrical insulation and polyurethane foam was employed for thermal insulation because of heat generation in the pipeline.

25843 SUPERCONDUCTING CABLE IN TEST. Heumann, H.; Koetzold, B. (AEG-Telefunken, Frankfurt am Main). Umsch. Wiss. Tech.; 74: No. 4, 123-124(15 Feb 1974).

A superconducting flexible dc-cable is described which is suitable for 5000 MW load, e.g., for the bulk power supply of a city center in the end of the eighties. The cable was tested in a closed circuit of 15 m extension up to 30,000 amps. After optimizing the cable layout field tests will start in 1979.

25844 TRANSIENTS IN A SUPERCONDUCTING DELAY LINE. Glebovich, G. V.; Migunov, L. V. Izv. Vyssh. Uchebn. Zaved., Radioelektron.; 17: No. 5, 64-69(May 1974). (In Russian).

Analysis of the expressions for the surface impedance Z_s, shows that it is convenient in practice to determine Z_s from the resistive and the reactive components characterizing the superconductor material. The pulse G(T) and transient H(T) characteristics of superconducting coaxial cables, linking them with the transmission coefficient are calculated approximately. Estimates of G(T) and H(T) of superconducting coaxial cables, manufactured from lead and niobium, are made employing rigorous formulas. It is shown that the transient period can be determined within an accuracy of 100% in the frequency band up to 30 GHz, when the bandwidth of the superconducting cable is 70 GHz.

25845 ELECTRICAL LOSSES IN SUPERCONDUCTING CABLES EXCITED BY A STEP VOLTAGE. Del Vecchio, P.; Sachrdoti, G.; Veca, G. M. (Univ., Rome). Elettrotecnica; 59: No. 9, 997-1005(Sep 1972). (In Italian).

Some examples are examined of dynamic stabilization for a superconducting cable. The calculations give an estimate for the diffusion velocity of the magnetic field inside the cable and for the associated heat dissipation. Several different configurations were used for the windings of the magnet. The cable itself was rectangular of a Type II superconducting material and was united with a similar cable of copper. Two cables were either in electrical contact or separated by an insulator. Several aspects relating to the dissipation process and therefore the effectiveness of stabilization are explained.

25846 FUTURE PROSPECTS FOR THE DISTRIBUTION OF ELECTRICAL POWER WITH OVERHEAD TRANSMISSION LINES AND CABLES. Abilgaard, E. Energ. Tech.; 25: No. 4, 101-110(Apr 1973). (In German).

The rapid increase in the use of electrical power requires not only the erection of large power stations but also the construction of overhead transmission lines and cable networks. The technical aspects of the transmission of very high powers over high-voltage transmission lines and new types of cables are considered. The possibilities of underground power transmission using unconventional cables (SF_6 insulated cables, cryogenic cables and superconducting cables) were investigated. Brief references are made to design and constructional features.

25847 SUPERCONDUCTING POWER CABLES: A REVIEW. Flugge, D.; Heidmann, G. (VEB, Oberspree, Ger.). Elektrie; 27: No. 7, 375-381(1973). (In German).

25848 NANOSECOND PULSE TRANSMISSION THROUGH SUPERCONDUCTING COAXIAL CABLE. Borodovskii, V. S.; Gal'perovich, D. Ya. Radiotekhnika (Moscow); 27: No. 11, 91-94 (Nov 1972).

Experimental data on the attenuation of a superconducting cable are used to calculate its transient characteristics. The experimental method and results are described.

25849 ADVANCES IN WIDE BAND COMMUNICATION BY WAVEGUIDE OPTICAL FIBRE AND SUPERCONDUCTING COAXIALS. Unger, H. G. (VDE, Munich). NTZ-Nachrtech. Z.; 26: No. 8, 346-351(Aug 1973). (In German).

Low loss H_{01}-propagation in lined circular waveguides, even through strong elastic curvature as well as mm-wave-repeaters with efficient solid state and filter circuits, render waveguide systems economically equivalent to wideband coaxial systems. Optical communication with glass fibers which also have low loss now may supplement coaxial or waveguide transmission, or even replace it if only the semiconductor laser operates reliably with sufficient lifetime. Superconducting coaxials enable wideband long distance communication without repeaters.

25850 BULK-POWER TRANSMISSION BY CABLES. Peschke, E. F. Siemens Forsch.-Entwicklungsber.; 2: No. 1, 46-57(1973).

At the present, only oil-filled cables are used for power transmission with voltages above 150 kV. The losses and the thermal properties of the cables and the neighboring ground limit the transmission capabilities of such cables with only natural heat dissipation. With forced cooling, however, the system capacities can be considerably increased. Completely new concepts must be developed for the more distant future. For the power range above 2000 MVA, SF_6-insulated tubular conductor systems and low-temperature cables seem to be promising developments.

25851 HIGH-VOLTAGE INSULATION SYSTEMS FOR RESISTIVE CRYOGENIC CABLES. Juchniewicz, J. (Wroclaw Polytechnic Inst.). Przegl. Elektrotech.; 49: No. 3, 104-108 (Mar 1973).

Three main insulation systems based on vacuum, cryogenic liquids, and paper impregnated with cryogenic liquids are discussed. Their main features (low dissipation factor and high voltage strength) make it possible to get insulation systems having much better parameters than conventional insulation, making the cryocables still more attractive. Emphasis is put on the importance of aging processes stimulating the final solution of the insulation systems. Account is given of work done in this field in Poland.

25852 PREBREAKDOWN CURRENTS AND BREAKDOWN VOLTAGES IN VACUUM AT CRYOGENIC TEMPERATURES. Allan, R. N.; Salim, A. J. (UMIST, Manchester, Eng.). J. Phys., D (London); 7: No. 8, 1159-1169(21 May 1974).

Investigations were conducted to measure the prebreakdown current and breakdown voltage between aluminum, copper, stainless steel, niobium and gold electrodes in vacuum and uniform fields at room, liquid nitrogen and liquid helium temperatures. The range of electrode spacings for the current measurements is 0.1 to 4 mm and for the breakdown voltage is 0.1 to 1.8 mm. Results are discussed.

25853 SUPERCONDUCTING TUNABLE-DIAPHRAGM TRANSDUCER FOR SENSITIVE ACCELERATION MEASUREMENTS. Paik, H.J. (Department of Physics, Stanford University, Stanford, California 94305). J. Appl. Phys. 47: No. 3, 1168-1178 (Mar 1976).

A very sensitive resonant superconducting accelerometer has been developed as a component of a cryogenic gravitational-radiation detector. The device consists of a superconducting test mass and superconducting coils carrying a persistent current. The displacement of the test mass modulates the inductances of the coils and generates an ac magnetic field which is detected by a Josephson-junction magnetometer. The restoring force provided by the magnetic field is used to tune the resonant frequency of the transducer. The expected sensitivity of the system is better than $10^{-12} g_E/Hz^{1/2}$ (g_E=9.8 m/s^2) when used to detect accelerations at frequencies lower than 50 Hz. The system has been thoroughly tested and is being used to detect small accelerations of a gravitational-wave antenna caused by the Brownian motion and other external disturbances. When used as a resonant displacement sensor in a gravitational-wave detector cooled to 3 mK, this transducer is capable of converting a displacement of 4×10^{-20} m at 1 kHz into an electrical signal detectable with unity signal-to-noise ratio for 1-Hz bandwidth. The gravitational-radiation-flux sensitivity implied by this is 0.1 erg/cm^2 Hz. This will make not only the observation of expected galactic events possible, but will allow one to extend the scope of observation beyond the Milky Way. The system can be modified to make a sensitive gravity gradiometer. When two accelerometers are coupled to the same Josephson-junction magnetometer with their transformer coils wound in the opposite sense, direct subtraction of acceleration signals can be accomplished. The system will be easy to build and mechanically rugged. The device in various applications is discussed and the theory of transducer energy coupling, frequency tuning, and parameter optimization is presented. Some experimental results confirming the theory are reported. Included are data showing the temperature dependence of the Q of a niobium diaphragm and the measurement of the low-frequency background acceleration of a magnetically levitated gravitational-wave antenna. (auth)

25854 ECONOMICS OF UNDERGROUND TRANSMISSION WITH CRYOGENIC CABLES. Graneau, P. IEEE Trans. Power Appar. Syst.; PAS-89: No. 1, 1-7(Jan 1970).

A detailed study is presented of the economics of conventional underground transmission lines utilizing oil-paper insulated pipe-type cables. Three cryogenic ac transmission lines, cooled, respectively, by nitrogen, hydrogen, and helium, are compared with conventional cables and overhead lines. The nitrogen-cooled system, so far the most simple form of cryogenic cable proposed is found to be the most attractive from the point of view of low-cost underground transmission.

25855 REFRIGERATION REQUIREMENTS OF THE LN_2 CRYOCABLE. Graneau, P.; Parish, H. C.; Smith, J. L. Jr. (Underground Power Corp., Weston, MA). J. Eng. Ind.; 93: No. 4, 1161-1165(Nov 1971).

The smallest size refrigeration plant likely to be required for liquid nitrogen cooled electric power transmission lines is considered. Nitrogen, neon, hydrogen, and helium cycles are compared and it is shown that a neon cycle has considerable potential. An outline is given of a practical plant utilizing the nitrogen cycle and mainly rotating machinery, all based on present-day technology. The advantages which evaporative cooling confers on the operation of LN_2 cryocables are explained.

25856 NEW INCENTIVES FOR UNDERGROUND TRANSMISSION. Power Eng.; 75: No. 12, 26-31(Dec 1971).

Offshore nuclear plants are providing a major stimulus for the development of extra-high voltage submarine transmission systems; longer range studies foresee the use of cryogenic cables to serve highly concentrated power production at mine-mouth locations and microwave systems to bring power from outer space solar energy collectors.

25857 SUPERCONDUCTORS FOR POWER TRANSMISSION. Snowden, D. P. Sci. Am.; 226: No. 4, 84-91(Apr 1972).

The rising demand for electricity conflicts with opposition to overhead transmission lines. Underground lines that are refrigerated to be superconducting may provide a solution.

25858 CASE FOR CRYOGENICALLY COOLED POWER CABLES. Graneau, P. Underground Eng.; 2: No. 2, 41-43(1971).

Cryogenic cables can only be justified on the basis of reduced capital cost. Capital savings are possible through reduced civil engineering work, elimination of paper insulation and, better line utilization.

25859 SPECULATION FOR THE FUTURE: SUPERCONDUCTING POWER TRANSMISSION BY LOW VOLTAGE CABLE. Merriam, M. F. (Univ. of California, Berkeley). Underground Eng.; 2: No. 3, 41-44, 56(1971).

Superconducting transmission and the possibility of low voltage high power dc transmission with multiple parallel paths are discussed.

25860 NEW METHOD OF IMPROVING THE STABILITY OF SUPERCONDUCTORS AGAINST FLUX JUMPING. Sutton, J. (Univ. of Wisconsin, Madison). J. Appl. Phys.; 44: No. 1, 465-471(Jan 1973).

The threshold magnetic field for flux jumping in a bulk irreversible Type-II superconductor is known to be independent of its bulk critical current density. The analysis shows that the flux jump field should be enhanced in a laminated superconductor in which the surface layer has a lower critical current density than the underlayer. Experiments in laminated samples of Nb-48 wt percent Ti alloys demonstrate an improvement in stability which is in good agreement with the theory. The technique may be useful in increasing the overload current rating of an ac superconducting power cable.

25861 PULSED FIELD LOSSES IN METAL-FILLED SUPERCONDUCTING MULTIFILAMENTARY BRAIDS. McInturff, A. D.; Dahl, P. F.; Sampson, W. B. (Brookhaven National Lab., Upton, NY). J. Appl. Phys.; 43: No. 8, 3546-3551(Aug 1972).

Work on the application of metallic filters to insulate and bond individual multifilamentary wires into a fully transposed conductor is summarized. As has been reported in earlier papers, conductors of this type have performed excellently in low-frequency pulsed magnets, but become coupled at relatively low values of db/dt, leading to high potential losses. Data are presented on metallic and intermetallic insulated braids showing excellent performance and exhibiting losses comparable to those of organically insulated braid for rise times less than 10 kG/s. These conductors are also able to achieve 90 percent of short sample critical current at db/dt 200 kG/s, although their losses are significantly higher at these high rates of field change.

25862 SUPERCONDUCTIVE MICROSTRIP EXHIBITING NEGATIVE DIFFERENTIAL RESISTIVITY. Huebener, R. P.; Gallus, D. E. (to U.S. Energy Research and Development Administration). US Patent 3,916,432. H01L29/66. 28 Oct 1975. Filed date 17 May 1974. 6p.

PAT-APPL-470,898.

A device capable of exhibiting negative differential electrical resistivity over a range of values of current and voltage is formed by vapor-depositing a thin layer of a material capable of exhibiting superconductivity on an insulating substrate, establishing electrical connections at opposite ends of the deposited strip, and cooling the alloy into its superconducting range. The device will exhibit negative differential resistivity when biased in the current-induced resistive state.

25863 SUPERCONDUCTING CABLES FOR MAGNETIC COILS. Meyer, G. Brown Boveri Rev.; 62: 490-495(1975).

Superconductors based on Nb-Ti alloys can be made into cables, consisting of a number of round filament wires, which can then be wound into magnet coils. The wires are twisted and the cable itself either braided or transposed. The main advantages of such cables relative to solid conductors lie in the flexibility of assembly and manufacture of the conductor and also in the large unit lengths which can be produced. As a result, a virtually unlimited number of configurations in the form of both hollow and solid conductors can be assembled from a limited number of basic wire types. The possibilities available and certain limiting restrictions are pointed out. (auth)

25864 HEAT TRANSFER TO HELIUM. Application to the Design of Heat Exchangers. Johannes, C. (L'Air Liquide, 38- Sassenage (France). Centre d'Etudes Cryogeniques). pp 449-460 of Heat Exchangers. 9. International Meeting, Paris, 16-18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974). (In French)

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

The discovery of superconductivity has lead to a new technology at very low temperatures. This technology utilizes liquid helium to maintain superconducting devices below their transition temperatures. These devices contain the heat exchangers for the circulation of the helium. The helium could be in two-phase flow or in single phase but near its critical point. A study of the heat transfer and pressure drop characteristics of helium in two-phase flow and in the supercritical state is described. The results are compared with existing correlations. For two-phase pressure drop two methods were used: one based on slip between phases and the other based on a homogeneous model. The heat transfer data are compared with a number of existing correlations. The author proposes the best methods for calculating helium heat exchangers.

25865 ELECTRICAL CONSIDERATIONS FOR AN AC SUPERCONDUCTING CABLE. Cairns, D. N. H.; Minors, R. H.; Norris, W. T.; Swift, D. A. (Central Electricity Research Labs., Leatherhead, Eng.). pp 145-151 of Low Temperatures and Electric Power. Paris; International Institute of Refrigeration (1969).

From conference on low temperatures and electric power; London, England (24 Mar 1969).

With conventional high power cables, Joule heating losses necessitates operation at high voltages (i.e., 275 kV and above). The limitations on power handling capacity and length, and the difficulties in manufacture and installation stems mainly from this practice. With superconducting cores it thus seems reasonable to examine high current cable designs first. Because the optimum voltage of a superconducting cable was not known, a possible future generator voltage was chosen for study since this could allow connections to load centers without the use of transformers. It was further argued that by considering a specific case, the more important design parameters, constructional problems and areas requiring research would be more quickly identified. The experience gained from such an exercise could then be used to assess and determine more favorable specifications. The electrical aspects of the investigation are discussed.

25866 COOLING OF SUPERCONDUCTING CABLES. Sellmaier, A. (Linde G, Hollriegelskreuth, Ger.). pp 171-178 of Low Temperatures and Electric Power. Paris; International Institute of Refrigeration (1969).

From conference on low temperatures and electric power; London, England (24 Mar 1969).

The development of superconducting cables may be divided in two parts. One part includes all electrotechnical questions and the special problems of the superconducting material. The other part includes all questions of the cryogenic envelope and refrigeration. Connections between the two parts are given by the necessary volume and weight of the conductors with their electrical insulation. The heat transfer from the cooling flow to the superconductor and its friction coefficient has an influence on the design of the cryogenic envelope. The problems are characterized by a great number of thermodynamic and electrical parameters, which are discussed.

25867 SPECIAL CRYOGENIC PROBLEMS ON THE PERFORMANCE OF SUPERCONDUCTING CABLES. Hildebrandt, U. (Linde G, Hollriegelskreuth, Ger.). pp 179-185 of Low Temperatures and Electric Power. Paris; International Institute of Refrigeration (1969).

From conference on low temperatures and electric power; London, England (24 Mar 1969).

Special cryogenic problems are dealt with in detail. As efforts in the realization of prototypes of such cables are made at present, it seems necessary to emphasize some of these problems in order that the relevance of cryogenics is adequately taken into account.

25868 STUDY OF PROBLEMS ASSOCIATED WITH THE COOLING OF A DIRECT CURRENT SUPERCONDUCTING CABLE. Schwab, A. M.; Delile, G.; Jegou, Y. (Electricite France, Clamart). pp 163-170 of Low Temperatures and Electric Power. Paris; International Institute of Refrigeration (1969). (In French).

From conference on low temperatures and electric power; London, England (24 Mar 1969).

The study of general problems is cooling a direct current superconducting cable via the circulation of liquid helium and nitrogen. This cryocable is equipped with refrigerating systems regularly spaced along its entire length; with regard to the cooling of this cable, one has first to consider two geometric parameters associated with the power carried by the cable and its service voltage and, secondly, its length. The characteristics of the fluids entering and leaving the cooling systems are a function of these parameters, as well as the number of cooling stations (or cable sections) from which one can calculate the total costs for minimum cooling needs. A certain number of simple and general laws were established which may be used directly to determine the general characteristics of direct current superconducting cables of any voltage capacity and lengths.

25869 PROTECTION OF SUPERCONDUCTING DEVICES AGAINST OVERLOAD. Dimensional Characteristics. Barret, P. H. (Electricite France, Clamart). pp 189-194 of Low Temperatures and Electric Power. Paris; International Institute of Refrigeration (1969). (In French).

From conference on low temperatures and electric power; London, England (24 Mar 1969).

In order to use superconductors in ac cables or transformers very exacting conditions must be satisfied because of the inevitable overloads particularly in case of a short circuit. The studies published previously accepted either a heavy overdimensioning of the apparatus or a non-availability of long duration in case of a short circuit. A protective device is proposed which avoids almost entirely both these drawbacks. The consequences of the use of this device from the point of view of both dimensioning and the exploitation of the grid are examined.

25870 1971 CONGRESS OF FRENCH SOCIETY ELECTRICIANS, NICE, FRANCE, SEPTEMBER 29–OCTOBER 3, 1971. Malakoff, France; French Society Electricians (1971).

The following topics were dealt with: cryoelectricity; automation of network systems; power superconductors and power transmission. 37 papers were presented, of which all are published in full in the present proceedings. Individual papers within the subject scope of this journal will be abstracted in this or a subsequent issue.

25871 POWER TRANSMISSION VIA THE SUPERCONDUCTING CABLE. Haid, D. A. (Union Carbide Corp., Tarrytown, NY). Mech. Eng.; 98: No. 1, 20-25(Jan 1976).

Underground superconducting ac transmission cables with capacities to 4000 MVA are under development to meet the expected urban loads in the 1990s. Such cable systems will be needed to provide the utilities with a solution for transmitting bulk power underground in an environmentally acceptable and reliable manner. In addition, a superconducting cable promises lower losses and higher transmission efficiencies in spite of its need to be refrigerated to a very low operating temperature. Topics discussed include: (1) current research in the power industry; (2) basic cable design; (3) the impact of rising fuel costs; and (4) the availability of helium. (auth)

25872 POMERANCHUK COOLING TO MILLIKELVIN TEMPERATURE WITHOUT FORMING BULK SOLID ^{3}He. Bukshpan, I.; Cederbaum, M.; Eckstein, Y.; Landau, J.; Levenwirth, H. (Israel Inst. of Tech., Haifa). pp 141-144 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

It has been found that the formation of bulk solid ^{3}He during Pomeranchuk cooling can be suppressed when large quantities of activated charcoal are included in the cell. Adiabatic compressional cooling experiments were performed reaching temperatures as low as 1 mK with a cell which contained 2.2 g of activated charcoal, in addition to the 14 cm^3 of ^{3}He. The absence of bulk solid ^{3}He was demonstrated by measuring time constants for a powdered CMN magnetic thermometer with respect to the pressure on the melting curve. It is hypothesized that the enormous surface area of the charcoal allows the solid ^{3}He to develop in a several monolayer thick, surface structure. 2 figures. (auth)

25873 COSMIC-RAY DISTURBANCES IN THERMOMETRY AND REFRIGERATION. Ninikoski, T. O. (CERN, Geneva). pp 145-147 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

Cosmic-ray heating effects have so far never been considered seriously. In this comment, experimental evidence is presented about charged particle heating of a carbon resistor thermometer below 20 mK, immersed in dilute solution in the mixing chamber of a dilution refrigerator. It is suggested that the residual heat leaks to massive nuclear demagnetization refrigerators be examined, in view of possibly seeing heating bursts originating from very high energy particle showers. 1 figure. (auth)

25874 LEIDEN DILUTION REFRIGERATOR. Pennings, N. H.; Taconis, K. W.; de Bruyn Ouboter, R. (Kamerlingh Onnes Laboratorium, Leiden). pp 397-399 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

A dilution refrigerator has been successfully operated in which superfluid ^4He is circulated instead of the usual ^3He. (auth)

25875 ELECTRIC POWER TRANSMISSION BY CRYO-CABLES. Deschamps, L.; Schwab, A. M. (Electricite France, Paris). pp 357-363 of 1972 IEEE Underground Transmission Conference. Supplement. New York; Institute of Electric and Electronics Engineers (1973).

From 1972 IEEE underground transmission conference; Pittsburgh, PA, USA (22 May 1972).

The object of this study was to determine when cryogenic techniques become of economic interest and how they rank in comparison with other new techniques when forseeable future needs are considered.

25876 CRYOGENIC INSULATION DEVELOPMENT FOR HIGH CAPACITY UNDERGROUND CABLE. Kalsi, S. S.; Hudis, M. (General Electric Co., Schenectady, NY). pp 558-566 of 1974 Underground Transmission and Distribution Conference. New York; Institute of Electric and Electronics Engineers (1974).

From 1974 underground transmission and distribution conference; Dallas, TX, USA (1 Apr 1974).

The development of insulation systems for liquid nitrogen-cooled underground cables is discussed. Measurements of the electrical breakdown stress, dissipation factor, contact angle and yield stress were made on candidate insulation materials as a function of screening materials, the material density and laminate structures are discussed.

25877 COST ANALYSIS OF DIELECTRIC STEMS FOR AC SUPERCONDUCTING POWER TRANSMISSION LINE. Meyerhoff, R. W. (Union Carbide Corp., Tarrytown, NY). pp 216-220 of Proceedings of the Tenth Electrical Insulation Conference. New York; Institute of Electric and Electronics Engineers (1971).

From 10th electrical insulation conference; Chicago, IL, USA (20 Sep 1971).

The effect on the overall system economics of varying the maximum allowed dielectric stress through the use of pressurized helium, vacuum or a solid dielectric was investigated. It is concluded that for a reasonable choice of dielectric parameters the increase or decrease in the total system cost from that calculated for the pressurized helium system with E/sub B/ equals 200 kV/cm would generally be less than 15 percent. For a given value of E/sub B/ the solid dielectric system will be more expensive than a pressurized helium or vacuum dielectric. Helium dielectric systems decrease monotonically as the value of E/sub B/ is increased. For the solid dielectric system the cost initially decreases as E/sub B/ is increased at high values of E/sub B/. The cost will increase with increasing E/sub B/.

25878 EXPERIMENTAL MODEL FOR A SUPERCONDUCTING TRANSMISSION LINE. Jensen, H. J. Ann Arbor, MI; Univ. of Michigan (1975). Vp. University Microfilms Order No. 70-25,25142.

Thesis (Ph. D.).

It is shown that the effective bandwidth of a superconducting cable is optimized by adjusting the ratio of mean free path L to coherence length Xi_0 to a value of approximately one (Xi_0/L equals 1). The optimum is independent of frequency. Data obtained from a time domain measurement is used to experimentally model the response and is shown to be in agreement with an approximation of the BCS and Ginzburg–Landau theories for Xi_0/L equals 1. A method of approximating the impulse response from the experimental data shows that a finite difference equation of order 4 relates the input to output within 3 percent. This may be useful in synthesizing a compensator for the system.

Heat Transfer and Fluid Flow

Refer also to abstracts 26503 and 28192.

25879 (SAND-75-0571) FINITE ELEMENT ANALYSIS OF PROBLEMS IN CONVECTIVE HEAT TRANSFER. Gartling, D.K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 34p. Dep. NTIS $5.00.

The finite element method has been applied to a general class of problems in convective heat transfer. The method was incorporated in a user-oriented computer program. Several typical problems were solved to demonstrate the accuracy and generality of the approach. (auth)

25880 (UCRL-50028-75-2, pp 16-21) CODE DEVELOPMENT GROUP. 1975.

In H-Division quarterly report, April–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

The mission of H-Division's Code Development Group is the development of time-dependent, compressible-fluid-mechanics programs. They are concerned with coupled Eulerian-Lagrangian methods (CEL and CHAMP) as well as with the generalized Eulerian method TEULER. The motivation in each case is related to developing codes (based on either known or new methods) that are aimed at solving several general classes of fluid-flow problems. Progress is reported on CELMOCH- a link from CEL to MOCHA; TEULER- a computational fluid dynamics development; CHAMP- a multifluid program; BLIP- a ballistically interactive particles code; and LEEK- a code to provide boundary conditions to HEMP in the absence of a physical boundary. (TFD)

25881 COIL SPRING VENTING ARRANGEMENT. McCugh, R. M. (to U.S. Energy Research and Development Administration). US Patent 3,913,599. F16K24/04. 21 Oct 1975. Filed date 30 Sep 1974. 8p.

PAT-APPL-510,839.

A simple venting device for trapped gas pockets in hydraulic systems is inserted through a small access passages, operated remotely, and removed completely. The device comprises a small diameter, closely wound coil spring which is pushed through a guide temporarily inserted in the access passage. The guide has a central passageway which directs the coil spring radially upward into the pocket, so that, with the guide properly positioned for depth and properly oriented, the coil spring can be pushed up into the top of the pocket to vent it. By positioning a seal around the free end of the guide, the spring and guide are removed and the passage is sealed.

25882 THERMAL CALCULATION FOR HYDROCARBON VAPOR CONDENSERS BY THE GLOYER METHOD. Its Extrapolation to Heat Transfer Calculation of Two Phase Streams. Grange, A. (Technip, 92- Rueil-Malmaison (France)); Jamin, B. (Institut Francais du Petrole (IFP), 92- Rueil-Malmaison). pp 105-127 of Heat Exchangers. 9. International Meeting, Paris, 16-18 Jun 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974). (In French)

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

The report resumes the calculation basis given by Walter Gloyer in his different papers and adds certain improvements acquired by long experience in thermal calculation engineering. The following points, necessary for the calculations, are examined in detail: verification of the thermal balances; calculation of the average temperature difference between the vapour and liquid, taking into account the efficiency of the exchanger; pressure loss of the phase stream; calculation of the various thermal resistances; calculation of the exchange surface. The basis of calculation being thus defined, a numerical application of the cooler calculation for hydrocarbon vapour + liquid mixtures with partial condensation is treated and enables the general use of this method to be considered for transfer problems in two-phase streams.

25883 HEAT TRANSFER DURING PHASE CHANGE. Boiling. Behar, M. (Centre Technique des Industries Aerauliques et Thermiques (CETIAT), 75- Paris (France)). pp 313-323 of Course on Heat Transfer. Lecture Proceedings. Lyon, France; Institut National des Sciences Appliquees (1973). (In French).

The fundamental mechanism of improving heat transfer in boiling is essentially due to a local effect of microconvection due to bubbles. The phenomena that occur in pure deaerated water in pool boiling, or in two-phase flow during forced convection boiling are briefly described. The interdependence between hydrodynamics and heat transfer is shown and some empirical correlations are given. (FR)

25884 HEAT TRANSFER IN CONDENSING SYSTEMS. Emerson, W. H. (National Engineering Lab., East Kilbride (UK)). pp 17-32 of Heat Exchangers. 9. International Meeting, Paris, 16-18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974).

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

The condensate-film heat-transfer coefficients on the exterior of a tube under conditions of inundation, vapour shear and the presence of non-condensing gas may be estimated from the equations which are reviewed in the paper, assuming that the conditions surrounding the tube are known. Estimating these conditions in a large condenser is a problem of some complexity

and computer programs for determining these conditions are discussed. Methods for estimating rates of condensing inside tubes with stratified or annular flow are reviewed and the changes in pressure drop resulting from condensation are examined. Surfaces for enhanced condensation include those treated or designed to give drop-wise condensation and those shaped to give locally-thin films under the influence of surface tension. The theories underlying both of those methods of enhancement are discussed and the results which can be achieved are reviewed. (FR)

25885 ANNULAR TWO-PHASE FLOW IN TUBES. Hewitt, G. F. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). pp 33-47 of Heat Exchangers. 9. International Meeting, Paris, 16-18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974).

From international meeting on heat exchangers, Paris, France (16 Jun 1971).

The paper reviews work carried out at the Atomic Energy Research Establishment, Harwell, England. Annular flow occurs in gas-liquid systems when part or all of the liquid phase flows on the tube wall in the form of a film. The first part of the paper describes investigations of two-phase flow regimes in both air-water and steam-water flows. The techniques used included high speed cine and x-ray photography. It is shown that the flow patterns can be represented in terms of superficial momentum fluxes and the dominant role of the annular flow pattern is confirmed. In annular flow, the liquid can flow partly as entrained droplets in the gas core. The existence of this phenomenon is the principal obstacle in the prediction of the characteristics of annular flow. The source of liquid droplets in the gas core is entrainment from interfacial waves and this emphasizes the importance of the structure of the film-core interface. The extensive work done at Harwell on interfacial structure in annular flow is reviewed. Experiments have been carried out on both vertical upflow and vertical downflow. The most important type of interfacial wave is the disturbance wave whose amplitude is typically about five times the mean film thickness. The droplets from the gas core are continuously redeposited on the film, and eventually, an equilibrium between entrainment and redeposition is established. The various experiments carried out at Harwell to elucidate this key mass transfer process are reviewed. Finally, the implications from the work to the design of plant involving annular flow are discussed, and the failure of current design methods are examined.

25886 FLOW PATTERNS AND PRESSURE DROP IN HORIZONTAL TWO-PHASE PIPE FLOW. Choe, W. G. Cincinnati; Univ. of Cincinnati (1975). 272p. University Microfilms Order No. 76-724,272.

Thesis (Ph. D.).

A study was made of the relationship between flow patterns and frictional pressure drop during cocurrent gas-liquid flow in horizontal pipelines. On the basis of a revised flow pattern classification, the key flow pattern transitions were (a) onset of homogeneous flow, (b) onset of separated flow and (c) intermittent-annular transition. The available flow pattern transition observations were compared with the existing correlations for these flow patterns transitions. The onset of homogeneous flow could be satisfactorily predicted by a correlation previously developed by Husain. The onset of separated flow could be predicted by an extension of the work of Wallis and Dobson. None of the existing correlations or any simple extension of correlations were found satisfactory for the annular-intermittent transition. Two theoretical approaches to the intermittent-annular transition were considered. The models were developed on the basis (a) a wave mechanism and (b) entrainment-deposition mechanism. The wave model was considered to provide the most satisfactory correlation of the data. On the basis of these correlations an overall flow pattern map is proposed. The available two-phase pressure drop correlations were compared to the world data on two-phase pressure drop. A world data bank, prepared by the University of Houston and the University of Calgary, was used for this purpose. It was found that an appreciably better fit of two-phase pressure drop in horizontal tubes could be obtained when separate correlations were used for the various flow pattern regions. In the intermittent and annular regions, the Lockhart–Martinelli correlation was best while in the separated flow region Hoogendoorn's correlation was superior. In the homogeneous region, a modified homogeneous approach provided the best agreement. (Diss. Abstr. Int., B)

25887 STUDY OF THE MECHANISMS OF SATURATED NUCLEATE POOL BOILING AND BURNOUT WITH TRANSIENT SURFACE TEMPERATURE MEASUREMENT. Yu. C. L. Lawrence, KA; Univ. of Kansas (1975). 102p. University Microfilms Order No. 76-1330.

Thesis (Ph. D.).

The mechanisms of nucleate boiling are not well understood, especially at high heat fluxes near the peak heat flux. In the study high-speed motion pictures of bubbles and vapor masses were obtained with superimposed indications of transient surface temperature. A special fast-response surface thermocouple was employed. The data show that at low heat fluxes, the surface temperature fluctuations are very localized and are largely caused by microlayer vaporization underneath growing bubbles. The frequency of the fluctuation increases with heat flux but not proportionally. At very high heat flux, the frequency and the magnitude of the fluctuations sometimes decreased. This suggests the existence of a thin liquid layer under irregular vapor masses. When the peak heat flux was approached, short periods of significantly increased surface temperature occurred indicating the surface had dried. The dryout of the liquid layer, the quench of the dry surface by liquid returning to the hot surface and the cooling from evaporation of the thin liquid layer on the surface can all be clearly identified from the surface temperature behavior. After the dry surface was quenched, periods of cooling as brief as 200 mu sec and as frequent as 3000 per second were sensed. Analysis shows this behavior can transfer more than the peak heat flux. The short cooling periods are believed due to microlayer evaporation beneath bubbles growing in the thin liquid film. The free surface between the vapor masses and the liquid layer is believed responsible for the quick bubble detachment. Evaporation from the liquid layer itself can also be a highly efficient heat transfer mechanism. (Diss. Abstr. Int., B)

25888 HYDRAULIC RESISTANCE IN CHANNELS WITH SURFACE BOILING. Knyazev, V. A. Sov. At. Energy (Engl. Transl.); 38: No. 1, 16-20(Jan 1975).

Translated from At. Energ. (USSR); 38: No. 1, 16-19(Jan 1975).

A theoretical model of turbulent flow in the region of boiling development was used to determine the effect of surface boiling on the hydraulic resistance in channels. Experimental data were compared with the theoretical results. It was concluded that the increase in hydraulic resistance in the channel at the stage of development of surface boiling may be attributed to the creation of an additional vortical resistance in the turbulent flow perturbed by boiling. The hydraulic effect of boiling is determined by the relative value of the "boiling" viscosity, as compared with the turbulent and molecular viscosity. In low-pressure circuits it is essential to allow for the pressure drop in the section corresponding to the development of surface boiling. (LCL)

25889 LAMINAR FILM CONDENSATION OF A LIQUID METAL IN A VERTICAL CHANNEL IN THE PRESENCE OF AN ELECTROMAGNETIC FORCE. Sheffield, J. W. Raleigh; North Carolina State Univ. (1975). 87p. University Microfilms Order No. 76-2422.

Thesis (Ph. D.).

An implicit finite-difference method is used to solve the boundary layer form of the conservation equations for both a laminar liquid phase and a turbulent vapor phase for the problem of liquid metal condensation on a vertical channel in the presence of an electromagnetic force. A special coordinate system, which adjusts its cross stream width to conform with the boundary layer, was used. The velocity and temperature profiles for the two-phase condensation problem are obtained by the numerical technique for different values of the applied electric and magnetic fields, the entrance interface velocity and the entrance liquid layer thickness. The condensation heat transfer was investigated and is discussed. The use of an electromagnetic force accelerated the liquid film and improved the condensation heat transfer for the case of a liquid metal. (Diss. Abstr. Int., B)

Materials Testing

Refer also to abstracts 26579 and 28142

25890 (AD/A-005174) A FURTHER INVESTIGATION INTO THE EFFECTS OF SCATTERED RADIATION UPON IMAGE SHARPNESS AND CONTRAST, USING COBALT-60 GAMMA RADIATION AND STEEL PLATES IN THE THICKNESS RANGE 3 TO 100 MM. Dowd, M.; Halmshaw, R. (Royal Armament Research and Development Establishment, Fort Halstead (UK)). Nov 1974. 20p. (RARDE-MEMO-16/74). NTIS $3.25.

See also report dated Mar 1974, AD-780348.

The effect of scattered radiation generated in the specimen, on the image of detail on a radiograph, has been further studied, using ^{60}C gamma-rays and steel plates. This work is a continuation of the investigation presented in RARDE Memorandum, 1/74, using different experimental conditions. It confirms that there is no effect on the image sharpness of small steps, due to the scattered radiation. (GRA)

25891 (AD/A-008452) IMAGE QUALITY IN NEUTRON RADIOGRAPHY. Technical Report. Halmshaw, R. (Royal Armament Research and Development Establishment, Fort Halstead (UK)). Feb 1975. 18p. (RARDE-4/75). NTIS $3.25.

The limitations and characteristics of the technique of thermal neutron radiography developed in RARDE, using a 5 MV Linac and the (X,n) reaction in beryllium, have been determined quantitatively using MTF values obtained for various converter screens. The effective source-size has been determined to be 80 to 90 mm dia at 840 mm source-to-detector distance, and the implications of this large dia on the choice of suitable converter screens are detailed. It is shown that with a small dia neutron source, neutron radiographs of image sharpness similar to radiographs taken with 150 kV x-rays are possible; with the present equipment the image sharpness is no better than is obtained with γ-rays from cobalt-60, and in most practical applications will be far worse than on any conventional x or γ-radiographs. (GRA)

25892 (AED-CONF-75-478-000) 2ND INTERNATIONAL CONFERENCE ON ION BEAM SURFACE LAYER ANALYSIS. Programme and Conference Abstracts. (Kernforschungszentrum Karlsruhe (F. R. Germany)). 1975. vp. INIS.

From 2nd international conference on ion beam surface layer analysis; Karlsruhe, F. R. Germany (15 Sep 1975).

The fundamental aspects and the applications of surface layer analysis are discussed. Techniques discussed include backscattering analysis, Auger electron spectroscopy, channeling, and microprobe analysis. (DE)

25893 (CEA-CONF-3128) NEUTRON RADIOGRAPHY DEVICES AND THEIR OWN APPLICATIONS. Farny, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services des Piles). Apr 1975. 10p. INIS.

From 1st scientific conference on the peaceful uses of atomic energy for scientific and economic development; Baghdad, Irak (7 Apr 1975).

Three kinds of neutron radiography devices were developed by the Saclay Reactor Department: underwater facilities for active rig or loop examination; extracted beam without γ for industrial applications; and a special unit for the examination of spent fuels several meters long from power plants. These devices are described and their applications and performances discussed. (FR)

25894 (ORNL-5130) NONDESTRUCTIVE TESTING DEVELOPMENT PROGRAM. Quarterly Progress Report for Period Ending December 31, 1975. Hill, M. R. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 48p. AT.

Progress in the development of USERDA sponsored nondestructive testing methods for power reactor components is reported. The methods include radiographic, ultrasonic, and eddy current testing. (TFD)

25895 PROBABILITY ANALYSIS OF A RELAY-TYPE RADIOMETRIC FLAW DETECTOR WITH TIME-DELAY SIGNAL SMOOTHING. Zav'yalkin, F. M.; Kvasnitsa, M. S. (Scientific-Research Inst. of Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 2, 156-159(1975).

Translated from Defektoskopiya; 11: No. 2, 36-40(1975).

An analysis method is given for a Poisson radiation source; the operating characteristics are derived, with graphs for various operating conditions. Recommendations are made on parameter choice, and optimal passbands are selected for the RC filter under given conditions.

25896 SCANNING-BEAM ABSORPTION SYSTEM PARAMETER SELECTION FOR EXTENDED ISOTROPICALLY EMITTING SOURCES. Valuev, N. P.; Latyshev, V. K. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 2, 142-146(1975).

Translated from Defektoskopiya; 11: No. 2, 19-25(1975).

A study was made of the effects of geometrical parameters (source size, collimator dimensions, separation between source, component, and detector, component size, defect size, etc. as regards the basic metrological characteristics, i.e., the signal-to-noise ratio and the error in defect location. The results apply to radiation flaw detectors using beam scanning. Relationships between these parameters are derived for two cases of considerable practical importance: the case of a fixed detector and synchronously moving source and detector. Recommendations are made on choosing the geometrical parameters for radioisotope scanning-beam devices.

25897 DATA-PROCESSING ALGORITHM FOR BETATRON FLAW DETECTION. Pokrovskii, A. V.; Tarasov, G. P.; Voronovski, V. F. (Scientific-Research Inst. of Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 2, 136-141(1975).

Translated from Defektoskopiya; 11: No. 2, 13-19(1975).

A defect-detection algorithm is described that uses the likelihood ratio of a two-dimensional correlated Gaussian sample and incorporates the joint modulation of the two distribution parameters by the defect signal. Detection characteristics are presented.

25898 SELECTION OF CERTAIN OPTIMAL PARAMETERS OF A γ-RAY FLAW DETECTOR WITH ANALOG DATA PROCESSING. Silyuk, V. F. Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 2, 131-135(1975).

Translated from Defektoskopiya; 11: No. 2, 7-12(1975).

A method is described for calculating the optimal value of certain parameters of a γ-ray flaw detector with consideration of the divergence of the radiation beam and instrument measurement error due to the statistical character of electron processes in the photomultiplier.

25899 HIGH TEMPERATURE AQUEOUS STRESS CORROSION TESTING DEVICE. Bornstein, A. N.; Indig, M. E. (to U.S. Energy Research and Development Administration). US Patent 3,922,903. G01N3/18. 2 Dec 1975. Filed date 27 Sep 1974. 4p. PAT-APPL-509,990.

A description is given of a device for stressing tensile samples contained within a high temperature, high pressure aqueous environment, thereby permitting determination of stress corrosion susceptibility of materials in a simple way. The stressing device couples an external piston to an internal tensile sample via a pull rod, with stresses being applied to the sample by pressurizing the piston. The device contains a fitting/seal arrangement including Teflon and weld seals which allow sealing of the internal system pressure and the external piston pressure. The fitting/seal arrangement allows free movement of the pull rod and the piston.

25900 PRUEFUNG METALLISCHER WERKSTOFFE. Zugversuch. (Testing of Metallic Materials. Tensile Test). Berlin, F. R. Germany; Beuth (May 1975). 16p. (In German). (DIN-50145).

16 figs.; 5 tabs. Substitute for DIN-50112, DIN-50143, DIN-50144, DIN-50146.

A standard is presented which is valid for tensile tests on all metallic materials with and without fine expansion measuring. Existing test standards for the tensile testing of certain materials or product forms and hardness and strain characteristics to be determined are discussed. A tensile test at the breaking point is also described. (DE)

25901 COMPARISON OF VARIOUS TECHNIQUES OF PREPARATION OF AUTORADIOGRAMS APPLIED TO THE DETERMINATION OF ^{210}Bi DISTRIBUTION IN ALLOY STRUCTURES. Cichomska, K.; Walis, L.; Radwan, M. (Inst. of Nuclear Research, Warsaw). ATOMKI (At. Kut. Intez.) Kozl.; 17: No. 3, 293-301(1975).

From 8th symposium on autoradiography; Visegard, Hungary (5 May 1975).

Using the tracer ^{210}Bi, decaying to ^{210}Po by β-emission, alloys of various types of tracer segregation were prepared by metallurgical method. Autoradiograms of the alloys were prepared in the following ways: detection of β particles (^{210}Bi) in AF-3 film; detection of α-particles (^{210}Po) in AF-3 film, in AR-10 film and in CA, CN, Cellit-T track-detectors. A comparison of the autoradiograms to obtain the most suitable techniques for studying distribution of an admixture in the alloy structure is discussed. (auth)

25902 NEUTRON RADIOGRAPHY APPLICATIONS. Farny, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Services des Piles). pp 4-12 of Neutron Radiography. Paris; Kodak-Pathe (1974). (In French)

Neutron radiography is presented as a method of nondestructive testing by transmission. The possible applications of neutron radiography include nuclear fuel testing; hydrogenated materials; light materials: C, B, Li, teflon; strongly absorbing and dense materials; brazing; and opacifiers.

25903 NEW TUBES AND TECHNIQUES FOR FLASH X-RAY DIFFRACTION AND HIGH CONTRAST RADIOGRAPHY. Charbonnier, F. M.; Barbour, J. P.; Brewster, J. L. (Field Emission Corp., McMinnville, Oreg. (USA)). pp 356-361 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps.). Paris, France; Association Nationale de la Recherche Technique [nd].

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

High energy electrons are particularly efficient in producing characteristic x-rays and soft polychromatic. A line of wide spectrum beryllium window flash x-ray tubes, ranging from 150 to 600 kV, has been developed to exploit this property. Laue and Debye Scherrer flash x-ray diffraction patterns have been obtained using a single 30 ns pulse exposure. X-ray diffraction tests obtained are shown. Extremely high contrast flash radiography of small, low density objects has been obtained using industrial film without screen. Alternatively, particularly at high voltages and for subjects which include a broad range of materials and thicknesses, special film techniques can be used to produce extremely wide latitudes. Equipment, techniques and results are discussed.

25904 THREE EXAMPLES OF NEUTRON RADIOGRAPHY TESTING. Joudioux, M. (Compagnie Francaise Thomson-Houston Hotchkiss-Brandt (CFTH-HB), 75- Paris). pp 21-23 of Nuetron Radiography. Paris; Kodak-Pathe (1974). (In French)

Three examples of neutron radiography concerning small components of pyrotechnical devices are given: an example of testing a detonating fuse, detonating fuse ends, and an explosive channel inside a metallic part. (FR)

25905 APPLICATION OF NEUTRON RADIOGRAPHY TECHNIQUES TO THE NONDESTRUCTIVE TESTING OF PYROTECHNICAL COMPONENTS AND SPACE SYSTEMS. Bouloumie, J. P. (Centre National d'Etudes Spatiales, 31- Toulouse (France)). pp 13-17 of Neutron Radiography. Paris; Kodak-Pathe (1974). (In French).

Neutron radiography is used at every level of the development of pyrotechnical components and associated systems. Two examples of failure analysis are given in the cases of pyrotechnical cutting machine and a pyrotechnical cartridge. (FR)

25906 ENHANCEMENT OF BLURRED PICTURES BY SPATIAL FILTERING. Wolton, W. P.; Redman, J. D. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). pp 182-189 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps.). Paris, France; Association Nationale de la Recherche Technique [nd].

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

Substantial improvement in the intelligibility of defocussed pictures has been demonstrated using coherent optical processing. Correction for penumbra effects, such as arise in radiography, has been demonstrated at optical wavelengths. Compensation for a Gaussian spread function, such as might occur in radiography via a salt screen, has also been demonstrated. A simulation has shown that much greater enhancement could be expected if improved phase filters could be made. (FR)

25907 NEUTRON RADIOGRAPHY APPLICATION IN AERONAUTICS. Arbonville, J. C. (Union des Transports Aeriens (UTA), 75- Paris (France)). pp 38-39 of Neutron Radiography. Paris; Kodak-Pathe (1974). (In French).

A method using neutron radiography for nondestructive testing of injection harnesses of jet engines is described. (FR)

25908 CONTROLE NON DESTRUCTIF PAR TECHNIQUES SPECIALES. Niveau 3: Ingenieurs. (Non-destructive Testing Using Special Techniques. Degree III: Engineers). Lyon, France; Institut National des Sciences Appliquees (1973). v.1 434 p.p. (In French).

The following topics are discussed: nuclear nondestructive testing (use of particle accelerators, neutron radiography); acoustic emission testing; mass spectrometry leak testing; thermal testing (infrared radiation, thermography, properties and applications of liquid crystals).

25909 NEUTRON RADIOGRAPHY IN ELECTRIC CONTACT INVESTIGATION. Johannet, P. (Electricite de France, 75- Paris. Direction des Etudes et Recherches). pp 34-37 of Neutron Radiography. Paris; Kodak-Pathe (1974). (In French).

The investigation of electric contacts by neutron radiography allows the visualization of the contact interface when contacts are closed and of the effective zones of current path with a precision of the order of a fraction of millimeter. Before closure, the contact surfaces are coated with a neutron absorber (grease containing boron, colloidal boron, etc.) and the absorber is driven away into zones without elementary contacts. (FR)

25910 NEUTRON RADIOGRAPHY TESTING OF DETONATING FUSES. Calzia, J.; Thibault, H. (Societe Nationale des Poudres et Explosifs (SNPE), 75- Paris (France)). pp 18-20 of Neutron Radiography. Paris; Kodak-Pathe (1974). (In French).

A neutron radiography method for testing a cutting detonating fuse is presented. (FR)

Nuclear Explosions

Refer also to abstracts 25401, 25731, 25737, 25910, 25976, 26091, 26503, and 26906.

25911 (AD/A-004942) PREDICTION TECHNIQUES FOR REFRACTION OF UNDERWATER EXPLOSION SHOCK WAVES: A SHIPBOARD COMPUTER PROGRAM. Goertner, J. A. (Naval Ordnance Lab., White Oak, Md. (USA)). 4 Dec 1974. 74p. (NOLTR-74-157). NTIS $4.25.

Because of the spatial and temporal variation of refractive conditions in the ocean, a capability is required for making onboard predictions of refractive effects on safe delivery ranges for submarine-launched nuclear weapons. The computer program (CARE) described indicates the feasibility of such a shipboard prediction capability. The program can be converted for use on any multipurpose computer having a storage capacity of about 16K, which is well within the specifications for currently used Navy computers. (GRA)

25912 (AD/A-004991) THE EFFECTS OF REDUCED CONFIGURATIONS AT (LASA) ON DETECTION SIGNAL-TO-NOISE RATIOS. Technical Report. Chiburis, E. F.; Ahner, R. O.; Chang, A. C.; Kerr, A. U. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 3 May 1974. Contract F08606-74-C-0006. 37p. (SDAC-TR-74-7). NTIS $3.75.

The effects of varying the configuration of the Large Aperture Seismic Array (LASA) on the detection signal-to-noise ratio observed in the Seismic Data Analysis Center Detection Processor are discussed. It is shown that a configuration for the LASA of thirteen subarrays (A, B, C, and D rings) with 16 sensors per subarray produces an average loss of 0.2 +- 0.3 db (one standard deviation of the mean) from the current configuration of seventeen subarrays (A, B, C, D, and E rings) using sixteen sensors per subarray. Reducing the number of subarrays to nine (A, B, and C rings) with only 7 elements per subarray produces an average loss of 3.5 +- 0.3 db. These results are in general agreement with known results on variation of noise reduction and signal loss as a function of subarray and subarray sensor selection. (GRA)

25913 (AD/A-005001) GROUND MOTION AND AIRBLAST MEASUREMENTS ON SHOT 6M OF DIAMOND ORE. Final Report. Vincent, C. T. (Physics International Co., San Leandro, Calif. (USA)). Dec 1974. Contract DACA07-72-C-0036. 58p. (PIFR-436). NTIS $4.25.

On Diamond Ore shot 6M, a 17 ton charge of nitromethane located at a depth of 5.85 meters (19.2 ft) in Bear Paw clay shale, Physics International Company measured (1) shock velocity up the unstemmed hole from charge surface to the ground surface, (2) stress at three locations along two radial lines 90 degrees apart, (3) horizontal and vertical particle velocity at one location along each radial line, and (4) airblast overpressures at the ground surface. Shock velocity up the unstemmed hole was twice the predicted value. Peak stresses were lower than predictions. Difficulties were encountered in measuring particle velocity because accelerations were higher than expected. Surface-level peak overpressures were greater than predicted for a buried TNT charge and less than the Sprint in-cell measurements. (GRA)

25914 (AD/A-005781) ANALYSIS OF SEISMIC DATA FOR THE RIO BLANCO EXPLOSION. Technical Report. von Seggern, D. H. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 19 Jun 1974. Contract F08606-74-C-0006. 88p. (SDAC-TR-74-9). NTIS $4.75.

Seismic analysis of RIO BLANCO, an underground nuclear explosion for gas stimulation, was performed using LRSM, LPE, and array recordings. Although a multiple detonation, RIO BLANCO was similar to other western U. S. shots and especially RULISON, another gas-stimulation explosion 55 km away. Magnitude-yield relations, shear generation, and spectral content of RIO BLANCO were not untypical for underground explosions. A source function which includes p(P) and P(spall) was inferred from the seismic data. An accurate location was obtained for RIO BLANCO using travel-time anomalies for RULISON. (GRA)

25915 (AD/A-005786) SOURCE STUDIES IN THE NEAR AND FAR FIELD. Semiannual Technical Report No. 3 (Part A), 1 May-31 Oct 1974. Turnbull, L. S.; Battis, J. C.; Sun, D. (Texas Instruments, Inc., Dallas (USA)). 30 Nov 1974. Contract F44620-73-C-0055. 51p. (TI-ALEX-(02)-TR-74-03(Pt.A)). NTIS $4.25.

See also report dated 30 Nov 1974, AD/A-004820.

A program has been undertaken to examine the seismic source in the near- and far-fields. Near field accelerogram spectra have been analyzed for corner frequency, seismic moment, and

stress drop. For the Bear Valley earthquake of June 22, 1973, a stress drop of 300 bars was obtained using Brune's source theory. The data sample, though, was insufficient to determine any empirical relationship between corner frequency and local magnitude and its association with stress drop. In our examination of far-field source spectral characteristics, de-multipathing procedures have been implemented on the PDP-15 interactive graphics system. Three-dimensional computer plots of double couple source spectra have been produced, and are being used in an exhaustive analysis of far-field spectral characteristics as a function of source configuration. (GRA)

25916 (AD/A-006194) SEISMIC DISCRIMINATION. Semi-annual Technical Summary Report, 1 Jul–31 Dec 1974. Chinnery, M. A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Dec 1974. Contract F19628-73-C-0002. 62p. NTIS $4.25.

See also report No. AD-785377.

This report describes 22 separate investigations in the field of seismic discrimination. These are grouped as follows: discrimination and evasion research (5 contributions); method for the determination of focal depth (4 contributions); global seismic network studies (4 contributions); studies of earth heterogeneity (4 contributions); source mechanism studies (3 contributions); and investigations of global seismic activity (2 contributions). (GRA)

25917 (AD/A-007043) STUDY OF TWO AUTOMATIC SHORT-PERIOD SIGNAL DETECTORS. Technical Report No. 9. Vela Network Evaluation and Automatic Processing Research. Lane, S. S. (Texas Instruments, Inc., Dallas (USA)). 6 Dec 1974. Contract F08606-74-C-0033. 32p. (TI-ALEX-(01)-TR-74-09). NTIS $3.75.

See also report dated 15 Nov 1974, AD/A-003676.

The Fisher detector and conventional power detector have been implemented on short-period data recorded at the Korean Seismic Research Station. It was found that false alarm rates varied so widely from day to day that no comparison between detectors could be made. However, a comparison between detectors with different integration times but the same false alarm rate revealed that integration time does not affect the probability of detection. (GRA)

25918 (AD/A-007044) EARTH NOISE AT VERY LONG PERIOD EXPERIMENT STATIONS. Technical Report No. 3. Vela Network Evaluation and Automatic Processing Research. Prahl, S. R. (Texas Instruments, Inc., Dallas (USA)). 27 Nov 1974. Contract F08606-74-C-0033. 77p. (TI-ALEX-(01)-TR-74-03). NTIS $4.75.

The report presents the results of a study of the noise characteristics of eleven Very Long Period Experiment (VLPE) stations. For the period from January 1972 through March 1973, 1503 one-hour vertical component and 846 one-hour three component noise samples were processed and analyzed for short-and long-term vertical component noise trends, three component spectra, and two-component coherence spectra. (GRA)

25919 (AD/A-007050) EVALUATION OF MATCHED FILTERS AND THE THREE-COMPONENT ADAPTIVE PROCESSOR FOR THE VLPE STATIONS AND VLPE NETWORK. Technical Report No. 5. Vela Network Evaluation and Automatic Processing Research. Strauss, A. C.; Tolstoy, A. I. (Texas Instruments, Inc., Dallas (USA)). 10 Oct 1974. 99p. (TI-ALEX-(01)-TR-74-05). NTIS $4.75.

The report describes the evaluation of the chirp matched filter, the reference waveform matched filter, and the three-component adaptive processor in terms of events from two seismic regions and one presumed explosion test region as recorded by stations of the Very Long Period Experiment. (GRA)

25920 (AD/A-007051) AN EXAMINATION OF SOME NEW AND CLASSICAL SHORT PERIOD DISCRIMINANTS. Technical Report. Shumway, R.; Blandford, R. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 8 Jul 1974. Contract F08606-74-C-0006. 53p. (SDAC-TR-74-10). NTIS $4.25.

Optimum linear and quadratic discrimination filtering techniques are developed for discriminating between short period seismic records originating from earthquakes and explosions. Linear and quadratic detection filtering and matched filtering are compared with the classical spectral ratio and complexity measure using a learing population of LASA array beams of 23 earthquakes and 15 explosions and a test population with 17 earthquakes and 11 explosions. The linear detection filter misclassifies one event in the test set whereas all other techniques misclassify between three and five events. It is shown that for the spectral ratio discriminant the discriminatory power lies in the ratio of .4 to .8 Hz energy to 1.0 Hz energy, and that the higher frequency energy has no additional discriminatory power. (GRA)

25921 (AD/A-008280) AN INTERACTIVE SYSTEM FOR LONG-PERIOD SEISMIC PROCESSING. Technical Report No. 11. Vela Network Evaluation and Automatic Processing Research. Ringdal, F.; Shaub, J. S. (Texas Instruments, Inc., Dallas (USA)). 10 Dec 1974. Contract F08606-74-C-0033. 56p. (TI-ALEX-(01)-TR-74-11). NTIS $4.25.

See also report dated 6 Dec 1974, AD/A-007043.

The report describes an interactive graphics processing system developed for the PDP-15 computer at the Seismic Data Analysis Center. The system is designed to process long-period seismic data and includes options for interactive bandpass filtering, matched filtering, spectral analysis and parameter measurements. The main intention of the program development has been to investigate the feasibility of using interactive graphics for event detection purposes in a potential world-wide seismic surveillance system. An evaluation of the expected operational capabilities of the system has been carried out, using data recorded by the Very Long-Period Experiment network as a source. Conclusions from this evaluation and recommendations for future study are presented. (GRA)

25922 (AD-A-009216) PNE (PEACEFUL NUCLEAR EXPLOSION) ACTIVITY PROJECTIONS FOR ARMS CONTROL PLANNING. Volume I. (Gulf Universities Research Consortium, Galveston, Tex. (USA)). 10 Apr 1975. Contract ACDA/PAB-253. 219p. NTIS $3.25.

See also Volume II, AD-A-009217.

The report projects the use of contained Peaceful Nuclear Explosion (PNE) technology up to 1990. In doing so, specific applications are identified and analyzed; critical factors affecting amount, rate and probability of use in the 1980's are discussed; delay times are analyzed; and conclusions which follow from the analysis are stated. The background discussion (Section 1) contains a brief historical discussion and chronology; and describes the advantages and disadvantages in general of PNE technology. The analysis methodology falls into four parts: technology, costs, regulatory problems, and economics (Section 2). Selected applications are examined in detail (Section 3). Criteria are stated for selection, with a list of 15 proposed applications. Five applications were selected for micro-analysis. (GRA)

25923 (AD-A-009217) PNE (PEACEFUL NUCLEAR EXPLOSION) ACTIVITY PROJECTIONS FOR ARMS CONTROL PLANNING. Volume II. Appendices. (Gulf Universities Research Consortium, Galveston, Tex. (USA)). Apr 1975. Contract ACDA/PAB-253. 273p. NTIS $8.50.

See also Volume I, AD-A-009216.

Topics discussed include oil shale; tight gas; storage; copper; oil stimulation; industry workshop on PNE applications; and projections of PNE use. (GRA)

25924 (AED-CONF-75-365-000, pp v) PHENOMENOLOGY OF EXPLOSIONS OF HYDROCARBON GAS-AIR-MIXTURES IN THE ATMOSPHERE. Koch, C. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

2 figs. With abstract. Available from ZAED.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. German)).

After deflagration-type ignition gas-air-mixtures reach velocities in the free atmosphere from only a few m/s to the order of 10^1 m/s. These velocities are not sufficient to induce a transition of the combustion process to a detonative process. In the deflagration combustion process the velocity of the flame front depends on the following main factors: 1) the type of the gas and the relevant type of combustion process, 2) the distribution of the concentration of gas in the free atmosphere, 3) the degree of molecular mixing, 4) effects of turbulence which can lead to a steady increase of the flame front velocity, 5) the possibility of thermal and catalytic formation of radicals. These parameters indicate that the mechanism of spreading of a combustible gas in the atmosphere is of decisive influence for the process of combustion. The paper discusses several chemical engineering topics, kinetics of chemical reactions, and gasdynamical phenomena relevant to the phenomenology of hydrocarbon gascloud explosions in the free atmosphere. For estimating the hazards which explosives and fuels present for the environment, a description by a model is not reliable, since the pressure values may vary in accordance with the ratio 1 : 67. Therefore, a distinction must be made between detonable and deflagrable substances. (DE)

25925 (CONF-760307-1) MEASUREMENT AND EVALUATION OF HIGH-RISE BUILDING RESPONSE TO GROUND MOTION GENERATED BY UNDERGROUND NUCLEAR EXPLOSIONS. Honda, K. K. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). 1976. 11p. Dep. NTIS $3.50.

From ASCE/EMD specialty conference on dynamic response of structures; Los Angeles, California, United States of America (USA) (30 Mar 1976).

As part of the structural response research program being conducted for ERDA, the response behavior of high-rise buildings in Las Vegas, Nevada, due to ground motion caused by underground nuclear explosions (UNEs) at the Nevada Test Site (NTS) has been measured for the past 12 years. Results obtained include variation in dynamic response properties as a function of amplitude of motion, influence of nonstructural partitions in the building response, and comparison of calculated and measured response. These data for three reinforced concrete high-rise buildings, all designed as moment-resisting space frames are presented. (auth)

25926 (CONF-760307-2) TESTING WALL PANELS FOR EARTHQUAKE RESPONSE. Freeman, S. A. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). 1976. 11p. Dep. NTIS $3.50.

From ASCE/EMD specialty conference on dynamic response of structures; Los Angeles, California, United States of America (USA) (30 Mar 1976).

As part of the structural response research program being conducted for the Nevada Operations Office of ERDA a testing program for the investigation of nonstructural wall panels subjected to racking was developed and conducted. The objectives of the testing program were to determine thresholds for damage to partitions due to horizontal adjacent story displacement in high-rise buildings and to gather data that can be used to determine the influence of nonstructural partitions on the structural response of high-rise buildings. In general, the wall panels were constructed to represent typical partitions used in high-rise building construction. Some of the panels were used for special parameter studies or for comparisons with other test programs. A specially designed testing frame simulated cyclic lateral displacement, parallel to the plane of the wall panels, that might be experienced during the response of a building to strong winds or earthquake motion. Stiffness and strength characteristics, estimates of equivalent viscous damping, and damage threshold results were obtained. The data appear to give a good approximate evaluation of the performance of non-load-bearing partitions under cyclic loading. (LCL)

25927 (CONF-760307-3) DYNAMIC RESPONSE CHARACTERISTICS OF REINFORCED CONCRETE STRUCTURES. Freeman, S. A.; Chen, C. K.; Czarnecki, R. M. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). 1976. 11p. Dep. NTIS $3.50.

From ASCE/EMD specialty conference on dynamic response of structures; Los Angeles, California, United States of America (USA) (30 Mar 1976).

A program of vibration investigations of two identical 4-story reinforced concrete test structures which were constructed in 1965 at the Nevada Test Site is summarized. These investigations were conducted as part of a structural response program associated with the detonation of underground nuclear explosions. The structures were built to obtain experimental data on the dynamic response characteristics of high-rise concrete buildings, ultimately leading to the development of improved techniques for predicting damage and response to ground motion. Information is included on the four-story test structure, test equipment and methods, methods of response data analysis, and comparison of calculated and measured dynamic response of reinforced concrete structure. The results showed that conventional modelling techniques could be used to accurately predict response in the elastic range. (LCL)

25928 (PNE-RB-75) PROJECT RIO BLANCO: ALTERNATE REENTRY WELL RB-AR-2 HOLE HISTORY. (Fenix and Scisson, Inc., Las Vegas, Nev. (USA)). Feb 1976. Contract E(26-1)-38. 50p. Dep. NTIS $5.00.

An account of the drilling operations for well RB-AR-2 which entered the middle chimney of the three-shot Rio Blanco Project is presented. (TFD)

25929 (SAND-75-0426, pp 4-7) ELECTRIC CONTACT ARCING. Cuthrell, R. E. Feb 1976.

In Sandia technology, Autumn 1975. (Sandia Labs., Albuquerque, N. Mex. (USA)).

Electrical contacts must function properly in many types of components used in nuclear weapon systems. Design, application, and testing of these components require detailed knowledge of chemical and physical phenomena associated with stockpile storage, stockpile testing, and operation. In the past, investigation of these phenomena has led to significant discoveries on the effects of surface contaminants, friction and wear, and the mechanics of closure on contact performance. A recent investigation of contact arcing phenomena which revealed that, preceding contact closure, arcs may occur at voltages lower than had been previously known is described. This discovery is important, since arcing may damage contacts, and repetitive testing of contacts performed as part of a quality assurance program might produce cumulative damage that would yield misleading life-test data and could prevent proper operation of the contacts at some time in the future. This damage can be avoided by determining the conditions under which arcing occurs, and ensuring that these conditions are avoided in contact testing.

25930 (UCRL-50028-75-2, pp 52-55) SPECIAL PROJECTS GROUP. 1975.

In H-Division quarterly report, April–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

In the Special Projects Group, individuals or small groups work on new projects or special problems. The work is relatively short-term and does not logically fit into the other six H-Division groups. Activities reported on include studies on fracture mechanics, shallow earth penetration concept, and shock wave data compilation. (TFD)

25931 ECONOMICS, HAZARDS, AND USES OF NUCLEAR EXPLOSIVES. Ratan, S.; Dhar, B. B. (Inst. of Tech., Benares, India). Indian Min. Eng. J.; 14: No. 6, 25-32(Jun 1975).

Hazards related to civil use of nuclear explosives are briefly reviewed. The uses of nuclear explosives include mining (fracturing of rocks and ores), excavation, oil and gas production, in-situ gasification of coal, sulfur extraction, cavity production for gas storage and liquid waste disposal. The hazards discussed include air blast, ground motion, and radioactivity. (TFD)

25932 APPARATUS FOR REDUCING SHOCK AND OVERPRESSURE. Walter, C. E. (to U.S. Energy Research and Development Administration). US Patent 3,913,481. F42B3/02. 21 Oct 1975. Filed date 17 Sep 1973. 6p.

PAT-APPL-398,262.

The design is given of an apparatus for reducing shock and overpressure particularly useful in connection with the sequential detonation of a series of nuclear explosives underground. A coupling and decoupling arrangement between adjacent nuclear explosives in the tubing string utilized to emplace the explosives is able to support lower elements on the string but yields in a manner which absorbs energy when subjected to the shock wave produced upon detonation of one of the explosives. Overpressure is accommodated by an arrangement in the string which provides an additional space into which the pressurized material can expand at a predetermined overpressure.

25933 SYSTEM FOR REMOTE CONTROL OF UNDERGROUND DEVICE. Brumleve, T. D.; Hicks, M. G.; Jones, M. O. (to U.S. Energy Research and Development Administration). US Patent 3,914,732. F42D3/00. 21 Oct 1975. Filed date 23 Jul 1973. 8p.

PAT-APPL-381,632.

A system is described for remote control of an underground device, particularly a nuclear explosive. The system includes means at the surface of the ground for transmitting a seismic signal sequence through the earth having controlled and predetermined signal characteristics for initiating a selected action in the device. Additional apparatus, located with or adjacent to the underground device, produces electrical signals in response to the seismic signals received and compares these electrical signals with the predetermined signal characteristics.

25934 IAEA SAFEGUARDS AND THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS. Stein, R. M. (International Atomic Energy Agency, Vienna). pp 101-121 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

IAEA safeguards responsibilities stem from specific statutory provisions. Different types of agreements are concluded by the Agency with Member States for safeguards application: project agreements, safeguards transfer agreements, unilateral submission agreements. States party to the Non-Proliferation Treaty are required to enter into safeguards agreements with the Agency. The principal objective of NPT is horizontal non-proliferation as opposed to vertical non-proliferation. The background to NPT, the basic undertakings provided for therein and their scope of application are described. An analytical study is made of the structure and content of safeguards agreements connected with NPT. Annexes giving the status of safeguards agreements, whether under NPT or not, and of ratification or accession of NPT, and the parties to the Tlatelolco Treaty are also included. (auth)

25935 TREATY FOR THE PROHIBITION OF NUCLEAR WEAPONS IN LATIN AMERICA (TREATY OF TLATELOLCO). Gonzalez-de-Leon, A. (OPANAL, Mexico City). pp 123-127 of Licensing and Regulatory Control of Nuclear Installations. Vienna: International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

The Tlatelolco Treaty established the first area inhabited by man in which nuclear weapons are prohibited. Eighteen Latin American States party thereto undertake to use all nuclear material and facilities exclusively for peaceful purposes. Special features on the Treaty are outlined; attention is called to obligations resulting therefrom that may require the adoption of appropriate legislation by the countries concerned in relation to the establishment of a national system of material control, the prohibition of transit of nuclear weapons and the status of foreign facilities over which effective jurisdiction is not exercised by a State party to the Treaty. (auth)

Protective Structures and Equipment

Refer also to abstract 25541.

ENVIRONMENTAL AND EARTH SCIENCES

25936 (AD/A-007872) AN INDIRECT METHOD FOR MEASURING SURFACE-BASED TEMPERATURE INVERSIONS. Memorandum Report. Stamulis, A. (Naval Research Lab., Washington, D. C. (USA)). Mar 1974. 19p. (NRL-MR-2748). NTIS $3.25.

An indirect method for determining and measuring surface-based temperature inversions is proposed. The instrumentation for this purpose is a constant air monitor that measures the natural radioactivity of the atmosphere and records it on a strip chart. By means of deflections in the normal background radioactivity, the beginning and end of the inversion, as well as the time of maximum deflection, can be determined. In addition, a prolonged deflection continuing into the afternoon indicates that an air episode or smog alert may be forecast. Comparison of this method with that used by the National Weather Service Forecast Office gives reasonable agreement. Differences are probably due to local climatic differences, topography, and to inclusion of data for Saturdays, Sundays, and holidays. (GRA)

25937 (BNWL-1964) RESUSPENSION OF MATERIAL DISPERSED BY ATMOSPHERIC DIFFUSION FROM A POINT SOURCE. Horst, T. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-1830. 55p. Dep. NTIS $5.50.

One year of hourly data from the Hanford Meteorological Tower has been selected to represent a typical climatological distribution of the meteorological variables which control atmospheric diffusion, deposition, and resuspension. This data was used in a surface flux model to predict the probable value of both the initial air concentration, accounting for the depletion due to deposition, and the consequent air concentration of resuspended material whose source is the material deposited on the ground by the initial plume. (auth)

25938 (CONF-741053-) PROCEEDINGS OF THE NATIONAL ENVIRONMENTAL RESEARCH PARK SYMPOSIUM, IDAHO FALLS, IDAHO, OCTOBER 22, 1974. (Idaho Coll., Caldwell (USA). Snake River Regional Studies Center). 1974. 62p. Dep. NTIS $4.50.

From national environmental research park symposium; Idaho Falls, Idaho, USA (22 Oct 1974).

ERDA programs for environmental research are reviewed briefly. Emphasis is placed on the advantages and disadvantages of the identification of a site at the Idaho National Engineering Laboratory (formerly National Reactor Testing Station (NRTS)) as a National Environmental Research Park for ecological research and wild life protection. Activities at the nation's first environmental research park at the Savannah River Plant near Aiken, South Carolina, are reviewed. The potential advantages are discussed of the identification of sites at Oak Ridge National Laboratory, Tennessee, Los Alamos Scientific Laboratory, New Mexico, Pacific Northwest Laboratory, Washington, Brookhaven National Laboratory, New York, Argonne National Laboratory, Illinois, Lawrence Livermore Laboratory, California, and the Puerto Rico Nuclear Center, Puerto Rico, as national environmental research parks. (CH)

25939 ESTIMATION OF THE BOREHOLE EFFECT ON STATIONARY DISTRIBUTION OF EPITHERMAL NEUTRONS IN A BOREHOLE-STRATUM MODEL. Kozachok, I. A.; Kulik, V. V.; Pirogov, V. I. (Inst. of Geophysics, Kiev). Dopov, Akad. Nauk Ukr. RSR, Ser. B; No. 11, 970-973(1975). (In Ukrainian).

On the basis of the solution of a problem on neutron slowing-down in a two-strata medium with a cylindrical boundary which was obtained by a new method, the epithermal neutron distribution from a point source is calculated in a borehole-stratum model. The function of a relative effect of a borehole is plotted as dependent on the sound length, borehole diameter and sand collector water saturation. (auth)

25940 ILMENITE EXPLORATION ON THE SENEGAL CONTINENTAL SHELF. Methods and Results. Horn, R.; Le Lann, F.; Scolari, G.; Tixeront, M. (Bureau de Recherches Geologiques et Minieres (BRGM), 45- Orleans (France)). Ind. Miner. (St.-Etienne, Fr.); 57: No. 7, 349-360(Mar 1975). (In French).

From the results of a study based on geomorphology, geophysics and sedimentology, it has been possible to point out, South of Dakar, the existence of a fossil lagoon (peat dated 8400 years BP) partly isolated from the open sea by a littoral sand bar at -25m and strongly eroded. To the North of Dakar, the unconsolidated sediments, with a thickness over 40m, are thinning out seawards and from North of Dakar, the unconsolidated sediments, with a thickness over 40m, are thinning out seawards and from North to South. This pattern reflects the action of the longshore current which overstates the drainage effect to the Cayar canyon. The distribution of ilmenites in the sediments is studied in terms of a possible exploitation; however, the grades are too low in the present economic conditions. (FR)

25941 PROCEEDINGS OF THE SEVENTEENTH CONFERENCE ON GREAT LAKES RESEARCH HELD IN HAMILTON, ONTARIO, 12-14 August 1974. Ann Arbor, MI; International Association for Great Lakes Research (1974). 845p. (CONF-740813-P1-P2).

Separate abstracts were prepared for three of the papers, two for inclusion in NSA and one for inclusion in ERA. Three papers were abstracted previously and appeared in NSA Vol. 30 as numbers 23998 and 29462 and in Vol. 32 as number 24333. (CH)

For abstracts of individual papers see: 25979 and 26021.

Minerals and Ores

Refer also to abstracts 25560, 26894, 28118, 28222, and 28266.

25942 (AAEC/E-365) RUM JUNGLE ENVIRONMENTAL STUDIES. Davy, D. R. (ed.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1975. 374p. Dep. NTIS (US Sales Only) $10.50.

Eleven articles covering various aspects of the environmental study of the Rum Jungle uranium mining project are compiled. Separate abstracts were prepared for each. (JSR)

For abstracts of individual papers see: 25943-25952 and 26097.

25943 (AAEC/E-365, pp vp, Chapter 1) MANAGERIAL HISTORY OF THE RUM JUNGLE PROJECT. Watson, G. M. Sep 1975.

In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).

A brief managerial history of the Rum Jungle project is given and an assessment is made of the cost and benefits in order to remedy any environmental pollution. (auth)

25944 (AAEC/E-365, pp vp, Chapter 2) GEOGRAPHY, GEOLOGY, AND MINING HISTORY OF RUM JUNGLE. Lowson, R. T. Sep 1975.

In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).

The geology and geography of the Rum Jungle region are described. A description is given of the effect on the environment of mining operations such as ore processing, effluent disposal, and the leaching of stockpiles and overburden heaps. (auth)

25945 (AAEC/E-365, pp vp, Chapter 3) POLLUTION CYCLE AT RUM JUNGLE: CONTROLLING FACTORS, BASIC MECHANISMS, AND DEGREE. Conway, N. F.; Davy, D. R. Sep 1975.

In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).

A description is given of the climatology of the Rum Jungle region including such factors as the rainfall, evaporation, and runoff coefficients. The river system and seasonal factors which affect the pollution cycle are also discussed. (auth)

25946 (AAEC/E-365, pp vp, Chapter 4) ANNUAL INPUTS OF POLLUTANTS TO THE FINNISS SYSTEM. Davy, D. R.; Jones, J. Sep 1975.

In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).

The Zn, Cu, and Mn pollution load carried by the East Branch downstream of the mine area was estimated in order to determine the annual input of pollutants to the Finniss River system. Results for the 1969-74 Wets are tabulated. (auth)

25947 (AAEC/E-365, pp vp, Chapter 5) WATER QUALITY IN THE RUM JUNGLE AREA. Davy, D. R.; Jones, J.; Lowson, R. T. Sep 1975.

In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).

Percentages of Zn, Cu, and Mn contaminants entering the East Branch of the Finniss River from its polluted tributaries were determined. An assessment was made of the pollution arising from each East Branch subcatchment. (auth)

25948 (AAEC/E-365, pp vp, Chapter 7) BIOLOGICAL INDICATIONS OF POLLUTION OF THE FINNISS RIVER SYS-

TEM, ESPECIALLY FISH DIVERSITY AND ABUNDANCE. Jeffree, R. A.; Williams, N. J. Sep 1975.
In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).
A study was conducted on the effects of Cu, Mn, and Zn pollution in the Finniss River system on the distribution and abundance of aquatic animals. (auth)

25949 (AAEC/E-365, pp vp, Chapter 8) FATE OF THE DISCHARGED HEAVY METALS. Davy, D. R.; O'Brien, B. G. Sep 1975.
In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).
Measurements were made in order to deduce the fate of heavy pollutants which were discharged during milling operations. The extent to which these metals have accumulated in the Finniss River floodplains and the significance of the accumulation with respect to the pastoral use of the plains are discussed. The metals investigated were copper, manganese, zinc and radium. (auth)

25950 (AAEC/E-365, pp vp, Chapter 9) RADIOLOGICAL ASPECTS. Davy, D. R.; O'Brien, B. G. Sep 1975.
In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).
A study was conducted of environmental contamination in the Rum Jungle area resulting from the release of radioactive substances. Radioactivity in the Finniss River system was sampled, exposure routes were identified and dose commitments were estimated. (auth)

25951 (AAEC/E-365, pp vp, Chapter 10) MODELLING OF HEAP BEHAVIOR. Clancy, B. E.; Ritchie, A. I. M. Sep 1975.
In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).
Modelling studies were conducted on the processes responsible for the bacterial oxidation of iron sulfides arising from mining wastes. It was concluded that the oxygen supply was the most likely rate limiting process. Hence any modelling of the oxidation process must conceive of a mechanism that can supply the comparatively large quantities of oxygen required to explain the ion concentrations. (auth)

25952 (AAEC/E-365, pp vp, Chapter 11) REMEDIAL PROPOSALS. Calder, G. J.; Richards, R. Sep 1975.
In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).
A description is given of a method which may help alleviate the pollution in the Rum Jungle area caused by mining operations. It is proposed that revegetation methods may counteract the main problems of erosion and oxidation of material. (auth)

25953 (DPST-75-138-1) SAVANNAH RIVER LABORATORY QUARTERLY REPORT, JANUARY-MARCH 1975. Hydrogeochemical and Stream Sediment Reconnaissance: Eastern United States. National Uranium Resource Evaluation Program. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 32p. Dep. NTIS $4.00.
The National Uranium Resource Evaluation (NURE) program was begun in the spring of 1973 to stimulate commercial uranium exploration in an attempt to meet the rapidly increasing national demand for uranium. This program was established to evaluate domestic uranium resources in the continental United States and to identify areas favorable for uranium exploration. In 1975, the Savannah River Laboratory accepted responsibility for hydrogeochemical and stream sediment reconnaissance of twenty-five states in the eastern United States. The distribution of uranium and associated trace elements in surface and underground waters and stream sediments will be systematically determined, and the data will be processed to locate favorable areas for the discovery of uranium districts with potential for commercial development.

25954 (INIS-mf-1751) EXPLOITATION METHODS OF THE "EL NOPAL" MINE. de la Vega, C. J. J. (Universidad Autonoma de Chihuahua (Mexico). Escuela de Ingenieria). 1973. 66p. (In Spanish). INIS.
A study was made of the most economic methods to be followed in the exploitation of the El Nopal ore deposit. The ore mined would be beneficiated at the mine. The methods proposed are based on a determination of the planes and sections of the deposit in order to mine only the richest ores. Cost evaluations are made of the operating and capital costs. The geological singularities of the region and the deposit are analyzed in some detail. (JSR)

25955 (PB-238658) ASSESSMENT OF URANIUM AND THORIUM RESOURCES IN THE UNITED STATES AND THE EFFECT OF POLICY ALTERNATIVES. Final Report. Burnham, J. B.; Brown, R. E.; Enderlin, W. I.; Hanson, M. S.; Hartley, J. N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. Contract NSF-C914. 223p. NTIS $7.25.
The principal objectives of the study were to analyze United States uranium and thorium resources; examine the state-of-the-art of uranium exploration, mining, milling, and environmental practices; and examine the effects of alternative governmental policy options on the price and availability of uranium. (GRA)

25956 (PB-240155) DETECTION AND DELINEATION OF FAULTS BY SURFACE RESISTIVITY MEASUREMENTS, SCHWARTZWALDER MINE, JEFFERSON COUNTY, COLO. Report of Investigations, 1974. Stahl, R. L. (Bureau of Mines, Denver, Colo. (USA). Denver Mining Research Center). Dec 1974. 33p. (BM-RI-7975). NTIS $3.75.
Comprehensive field tests were made at the Schwartzwalder Mine, Jefferson County, Colorado, to determine whether surface geophysical techniques could be used to detect and delineate faults in uranium deposits. The tests included seismic refraction, magnetometer, electrical resistivity, airborne infrared thermal scanning and airborne photography. Of the several geophysical techniques tested in the field, horizontal resistivity profiling with electrode spacings in the range 10 to 15 feet was most diagnostic of faults. The method is quick, cheap, highly accurate, and one that can be easily used by personnel employed by mining companies to detect and delineate faults. (GRA)

25957 (TID-27001) SUMMARY OF RESERVE AND RESOURCE DATA ON COAL, URANIUM, AND OIL SHALE IN THE STATES OF MICHIGAN, OHIO, KENTUCKY, TENNESSEE, WEST VIRGINIA, NORTH DAKOTA, SOUTH DAKOTA, MONTANA, WYOMING, COLORADO, AND UTAH. Anderson, J. J.; Feldmann, R. M.; Palmer, D. F. 12 May 1975. 61p. American Petroleum Inst., Kent, OH.
A section is devoted to each state, each section including a contents and summary statement, resource-inhibition map, and tabulated data. 38 references. (JGB)

25958 ZONY OKISLENIYA GIDROTERMAL'NYKH MESTOROZHOENII URANA. (OXIDATION ZONE OF HYDROTHERMAL URANIUM DEPOSITS). Belova, L. N. Moscow; Nedra (1975). 158p.
The process of formation of oxidation zones in general and of oxidation zones of hydrothermal uranium deposits in particular is discussed. The topics considered are the change in the oxidation processes, zonality, basic factors controlling the development of the oxidation zone, and the role of each of these factors. Classifications of types of oxidation zones of hydrothermal uranium deposits are examined. Nine types of oxidation zones are identified and the basic characteristics of four of them are described. From the characteristics of the oxidation zones it is possible to make a possible evaluation of the deposits. As examples the crystalline form and pseudomorphosis of two minerals are analyzed. (tr-auth)

25959 POGREBENNYE OREOLY RASSEYANIYA GIDROTERMAL'NYKH MESTOROZHOENII URANA. (BURIED DISPERSION HALOS OF HYDROTHERMAL URANIUM DEPOSITS). Mezentsev, O. K. Moscow; Atomizdat (1975). 136p.
A description is given of underground dispersion halos of hydrothermal uranium deposits and the conditions for the formation of residual and superposed halos. Methodical recommendations and examples are given of the interpretation of secondary underground dispersion halos. The use of dispersion halos for forecasting uranium reserves in deposits from the concentration of residual dispersion halos and for evaluation of the mobility of ore elements in the hypergenesis area is considered. The behavior of uranium and the chemical elements accompanying it in ore processes is characterized. The significance of epigenetic processes in the formation of residual and superposed dispersion halos is shown. (tr-auth)

25960 IZOTOPNOE FRAKTSIONIROVANIE PRIRODNOGO URANA. (ISOTOPIC FRACTIONATION OF NATURAL URANIUM). Chalov, P. I. Frunze, USSR; Izdatel'stvo Ilim (1975). 236p.
Investigations on the isotopic fractionation of natural uranium are generalized. After a discussion of methodical questions a brief description is given of the history of the discovery of a non-equilibrium state between ^{234}U and ^{238}U in natural formations and conclusions are drawn on its prevalence. The following topics are then examined: mechanism for the separation of isotopes of the radioactive series under natural conditions, regularities in the separation of long-lived isotopes of the uranium series (including ^{234}U and ^{238}U) during destruction of the initial U ore in deposits, modeling of the processes for the accumulation of non-equilibrium U in natural system for determination of their absolute age, and examples of the dating of natural objects from the non-equilibrium

U. Results of the search for recoil atoms of ^{235}U in some U fractions isolated from natural compounds are described. (tr-auth)

25961 HEMATITE FORMATION MECHANISM IN THE CONTACT OF MAGNETITE–URANIUM MINERAL. Matyash, I. V.; Rakovich, F. I.; Ivanitskii, V. P. (Inst. of Geochemistry and Mineral Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 11, 974-977(1975). (In Ukrainian).

A mechanism is suggested for hematite formation accounting for the frontal movement of the hematite-magnetite "boundary," coming from the considered movement of diffusing oxygen with a significant gradient of its concentration and assuming that there might exist nonstoichiometry by oxygen for coexisting phases magnetite-hematite. (auth)

25962 WORLD URANIUM RESOURCES. At. Strom; 21: No. 9/10, 93-95(Sep 1975). (In German)

5 figs.; 2 tabs.; 2 refs.

The latest published figures of the main uranium producing regions of the western world are reviewed. (DE)

25963 URANIUM. Willis, J. L.; Stevens, B. P. J. (comps.). Mineral Industry of New South Wales, No. 43. Sydney; Geological Survey of New South Wales (1974). 58p. $1.00.

The occurrence and distributions of uranium deposits in New South Wales are described. The geology and prospecting for uranium minerals are discussed briefly. (AT)

25964 UNDERWATER NODULES: MINING RESOURCES. Ind. Miner. (St.-Etienne, Fr.); 57: No. 7, 361-363(Jul 1975). (In French).

Two processing methods (NH_3 leaching and SO_4H_2 leaching) were studied from an economic point of view: investment, processing costs and freight charges. (FR)

25965 EVOLUTION OF THE MINING METHODS IN THE MINES OF THE COMMISSARIAT A L'ENERGIE ATOMIQUE. Bavoux; Roussel; Tison (Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service des Travaux Miniers). Ann. Mines; No. 5, 63-74(May 1975). (In French).

The Commissariat a l'Energie Atomique produces 500,000 t of ores per year in its 3 mining centres. The lode deposits are complex and irregular. Up to 1972, 90% of the production came from levels worked by rise stoping with water-stowing and often with an important timbering and very little mechanization. It has been possible to increase mechanization by eliminating timbering which was made feasible at the Croizille and Forez Centres, by the dip stoping method under reinforced concrete floor or cemented water stowing, and at the Vendee Centre by keeping the rise stoping but using roof bolting instead of timbering. These methods are described; the consequent improvement of output and working conditions that they permitted are emphasized. (FR)

25966 ABSOLUTE AGE OF DISSEMINATED URANINITE IN WHEELER BASIN, GRAND COUNTY, COLORADO. Ludwig, K. R.; Young, E. J. J. Res. U.S. Geol. Surv.; 3: No. 6, 747-751(1975).

Uranium and lead isotopic analyses of monazite and uraninite from the disseminated uraninite occurrence at Wheeler Basin, Grand County, Colo., indicate that these minerals formed 1,446 +- 20 m.y. ago. This time correlates well with intrusion of the Silver Plume Granite. The uraninite and monazite were also affected by a later disturbance at 880 +- 130 m.y., but show essentially no effects of subsequent events. This secondary disturbance may have been due to intrusion of dikes related to the Pikes Peak batholith, dated at 1,041 +- 13 m.y. ago. (auth)

25967 GEOCHEMICAL EXPLORATION 1972. Proceedings of the Fourth International Geochemical Exploration Symposium Held in London, 17–20 April 1972. Jones, M. J. (Ed.). London; Institution of Mining and Metallurgy (1972). 454p.

Thirty-seven papers were presented. Four, entitled (a) fission-track radiography of uranium and thorium in radioactive minerals, (b) application of fission-track and neutron activation methods to geochemical exploration, (c) application of neutron activation analysis to the evaluation of placer gold concentrations, and (d) nondestructive determination of metals in rocks by radioisotope x-ray fluorescence instrumentation, were in NSA scope and separate abstracts were prepared for them. (UK)

Radioactivity Monitoring and Transport

Refer also to abstracts 25950, 25987, 25992–25995, 26030, 26325, 26897, 26902, and 28132.

25968 (AED-CONF-74-725-000(Vol. 2), pp 384-402) RADIOECOLOGY OF THE OCEAN AND THE INLAND WATERS. Feldt, W. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

Three very different ecosystems can be studied in aquatic radioecology: the open sea, the shelf regions of the coast, and the inland waters (to be subdivided into stagnant and running waters). The total amount of radioactive pollutants in the oceans in the year 1970 was estimated to be $2\text{-}6 \times 10^8$ Ci of fission and activation products and 10^9 Ci of tritium. The greater part is located in the surface layer which has a thickness of 800 m. The radiation protection problem of deep-sea dumping of radioactive waste is discussed by the example of the ENEA's experimental dumping between 1967 and 1971. The shelf regions of the coast are an intensively populated ecological system which is characterized by a wide variety in all links of the food chains and by the raising of fry. In 1972, about 35 Ci Sr-90 and Cs-137 have been discharged into the Deutsche Bucht by the rivers Ems, Weser, and Elbe. The manifold utilization of this region poses some special problems of radiation protection which are discussed in detail by the example of a few measured values. With increasing frequency, nuclear power stations are constructed near the big rivers. The extremely complicated interaction processes between the biotic and abiotic components in the tidal regions bring about some special problems which are illustrated by a few examples. The concept of "acceptable activity admission" is discussed, and methods for its determination are described. (DE)

25969 (AED-CONF-74-725-000(Vol. 2), pp 403-431) RADIOECOLOGY OF THE DANUBE. Ruf, M. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

In consequence of the deficient energy provision, a larger number of power plants is likely to be constructed also along the water reservoir of the river Danube which is longer than 2,700 km. The Danube capacity for radioactive waste with regard to all critical pathways of radioactive substances to man and to the radiation dose limits for the population is of interest in this connection. The waste release of the 237-MWe-power plant Gundremmingen (KRB) has been taken as an example for ecological investigations of the behavior of radioactive waste substances in the Danube. The evaluation of the population radiation dose resulting from radioactive waste release was based on the ecological facts as well as on references. A preliminary recommendation concerning the Danube capacity for radioactive waste products has been worked out. (DE)

25970 (AED-CONF-74-725-000(Vol. 2), pp 432-443) PRESENCE AND DIFFUSION OF RADIOACTIVE MATERIALS IN THE OCEAN. Kautsky, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The water of the oceans contains about 5×10^{11} Ci of natural radioactivity. About 10^9 Ci of fission and activation products has until now been introduced into the ocean by nuclear fission–in particular by the explosion of atomic bombs. The artificial radioactive isotopes from nuclear explosions are distributed worldwide in all maritime regions, with their main concentration in the northern hemisphere. In contrast to this, the increasing amount of fission and activation products emitted by nuclear facilities have until now been almost exclusively found in the coastal regions. The great bulk of these substances is emitted by nuclear fuel reprocessing plants. The discharge of liquid radioactive wastes from reprocessing plants at Cherbourg, Windscale (Irish Sea), and Dounreay (Scotland) into the sea enables observations of the distribution of the labelled waters on their way through the North Sea and adjacent regions to be made. According to recent

measurements, the time of transport between, say, the English Channel and the Deutsche Bucht is about a year. Of course these transport mechanisms also apply to other soluble pollutants. (DE)

25971 (AED-CONF-74-725-000 (Vol. 2), pp 468-492) ENVIRONMENTAL CONTROL UNDER THE PRESERVATION-OF-TESTIMONY PROCEDURE DISCUSSED BY THE EXAMPLE OF THE PHILIPPSBURG NUCLEAR POWER STATION. Blaser, W. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The paper illustrates that environmental monitoring near nuclear facilities is carried out before start-up, during normal operation and after incidents for the determination of the environmental effects and for purposes of preservation of testimony in the interest of operators, control authorities, and the general public. Yet whereas before start-up attention is focussed on environmental measurements, exact measurements of emission together with the continuous monitoring of the short-time diffusion situation are indispensable during normal operation or in cases of accidents involving increased emission. This means that adequate and reliable measurements of every single parameter–including meteorological parameters–must be carried out so that sufficiently exact data stored in computers will be at hand in cases of emergency. (DE)

25972 (AED-CONF-74-725-000 (Vol. 2), pp 518-522) THE CONCENTRATION OF NATURAL RADIOACTIVE MATERIALS IN BUILDING MATERIALS. Schmier, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

A survey is given on the results in hand on the natural radioactivity of building materials. It is shown that only a small percentage of building materials has an increased content of radioactive materials. The results are compared with approximate values given in a Russian publication. (DE)

25973 (AED-CONF-74-725-000 (Vol. 2), pp 537-554) THE CONTENT OF NATURAL RADIOACTIVE MATERIALS IN PHOSPHATE FERTILIZERS AND THEIR CONTRIBUTION TO THE RADIATION EXPOSURE OF THE HUMAN POPULATION. Pfister, H.; Pauly, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The Ra, Th, and K-40 content of the most important phosphate fertilizers used and authorized in the FRG was determined by γ-spectroscopy. The results, together with statistical data on the consumption and use of fertilizers, were used for an estimation of the contribution of γ-radiation from phosphate fertilizers to the external population exposure in the FRG. (DE)

25974 (AED-CONF-74-725-000 (Vol. 2), pp 555-569) THE RADIUM AND URANIUM CONTENT OF PHOSPHATE FERTILIZERS. Arndt, J.; Aurand, K.; Ruehle, H.; Wolter, R.; Schmier, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

A number of brands of phosphate fertilizers and the crude phosphates used in their production were examined for their content of natural radioactive sources. The amount of radioactive materials introduced into the soil by phosphate fertilizers is estimated. (DE)

25975 (AED-CONF-74-725-000 (Vol. 2), pp 605-614) EFFECTIVE RADIATION EXPOSURE OF THE POPULATION LIVING IN THE IMMEDIATE ENVIRONMENT OF A NUCLEAR FACILITY. Nagel, E. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The author investigates the contribution of various artificial radiation sources (Ar-41, scattering radiation from strong irradiation facilities) on the radiation load of persons living practically on the borderline of a nuclear research facility. He tries to take into account the contribution of the buildings themselves to the radiation load and their shielding factor against external sources as well as, on the other hand, the habits of this critical section of the population. The measurements have been carried out with sensitive ionization chambers and with thermoluminescence dosemeters (CaF_2, LiF). The effective radiation loads thus calculated are compared with the local dose which has been determined at the same time and by the same methods. (DE)

25976 (LA-UR-76-318) SUMMARY OF RECENT STUDIES OF SOIL PLUTONIUM IN THE LOS ALAMOS AND TRINITY SITE ENVIRONS. Nyhan, J. W.; Hakonson, T. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1976. Contract W-7405-eng-36. 56p. (CONF-760214-2). Dep. NTIS $4.50.

From conference on actinide sediment reaction; Richland, Washington, United States of America (USA) (10 Feb 1976).

The first plutonium was sent to the Los Alamos Scientific Laboratory (LASL) in 1944 from the Oak Ridge and Hanford reactors for use in synthesizing the first atomic bomb, which was subsequently detonated at Trinity Site in New Mexico. During the last 32 years the LASL has developed an outstanding capability in many scientific fields required to support research in weapons technology and in other uses of nuclear energy. The fabrication and experimental activities required for this effort have resulted in additions of plutonium in industrial effluents to Los Alamos soils, just as the Trinity soils received fallout plutonium after the 1945 Trinity detonation. Formal radioecology-soils studies relative to soil-actinide relationships has been mainly field-oriented and complements transuranic research dealing with the biota of several study areas. The current soil actinide research performed within three liquid effluent-receiving areas at Los Alamos and along the fallout pathway of Trinity, the first nuclear detonation, are summarized.

25977 (WaBoLu-17/74) NATURAL RADIOACTIVITY IN PHOSPHATE FERTILIZERS. Arndt, J.; Aurand, K.; Ruehle, H.; Schmier, H.; Wolter, R. (Bundesgesundheitsamt, Berlin (F. R. Germany). Inst. fuer Wasser-, Boden- und Lufthygiene). Dec 1974. 16p. (In German). INIS.

6 figs.; 11 tabs.; 12 refs. Available from ZAED.

The activity concentrations determined of ^{226}Ra, ^{232}Th, and ^{40}K in nCi/kg P_2O_5 for the five most important kinds of fertilizer as well as their percent share in the economy year 1973/74 in the FRG are compiled in a table. From these values, the consumption of 0.917 million tons P_2O_5 and from an average annual fertilizer covering of 68.3 kg/ha, one can calculate a distribution of 32 Ci ^{226}Ra, 1 Ci ^{232}Th, and 543 Ci ^{40}K over the total agriculturally used area, in other words a deposit of 2.4 μCi ^{226}Ra, 0.07 μCi ^{232}Th, and 40.5 μCi ^{40}K per ha. Taking a pessimistic view, an external radiation exposure of 0.11 mrad/a was calculated for gonads and bone marrow. If the total accumulation of ^{226}Ra (38% of the radiation exposure) from phosphate fertilizers from the ground during the last 80 years is assumed, then there is an exposure of 1.7 mrad/a for individual members of the population and 2.0 mrad/a for those occupied in agriculture. (DE)

25978 STABLE AND RADIOACTIVE POLLUTANTS IN A SCANDINAVIAN GLACIER. Jaworowski, Z. (Central Lab. for Radiological Protection, Warsaw); Bilkiewicz, J.; Dobosz, E.; Wodkiewicz, L. Environ. Pollut. (London); 9: No. 4, 305-316(Dec 1975).

Radium-226, lead-210, uranium, and cadmium are dispersed in the atmosphere by industrial activity. Their concentrations, together with that of cesium-137, were determined in the fossil and contemporary ice samples from Storbreen glacier in Norway. During the past several hundred years concentrations of these nuclides in ice increased many times, although the glacier is remote from the industrial sources of pollution. This suggests the long distance migration of these pollutants from industrial centres located in more southerly regions, where pollution of glaciers was found to proceed more rapidly. (auth)

25979 STUDIES OF PLUTONIUM CYCLING AND SEDIMENTATION IN LAKE MICHIGAN. Wahlgren, M. A.; Nelson, D. M. (Argonne National Lab., IL). pp 212-218 of Proceedings of the Seventeenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1974).

From 17th conference on Great Lakes Research; Hamilton, Ontario, Canada (12 Aug 1974). See CONF-740813-P1.

Estimates of cumulative deposition, together with the results of extensive lakewide sampling in 1972, yielded estimates of mean halftimes for removal from the water column of Lake Michigan of 1.0 ± 0.3 yr for ^{239,240}Pu, and 1.4 ± 0.3 yr for ^{137}Cs. However, data from 1971, 1972 and 1973 water samples indicate that the recent half-time is much greater than the 1963-1972 average, presently being on the order of 3 to 4 yrs for both ^{239}Pu and ^{137}Cs. The longer turnover time is consistent with the ^{137}Cs turnover time in the water column deduced from analysis of preserved Lake Michigan alewives. Water filtration experiments have demonstrated that greater than or equal to 75 percent of the plutonium is nonfilterable and is present as colloid or sub-colloidal sized fractions. At an offshore station near Grand Haven, Michigan, the concentration of ^{137}Cs in the epilimnion underwent a slight but significant decline from June to November, whereas ^{239}Pu was reduced to a small fraction of its spring value. In net plankton samples dominated by phytoplankton a much lower mean ^{137}Cs:^{239}Pu ratio is observed than in water samples, indicating a preferential sorption of ^{239}Pu over ^{137}Cs by phytoplankton. The results of these experiments suggest that sorption by phytoplankton (and the subsequent rapid settling from the epilimnion of phytodetritus and/or zooplankton fecal pellets) is responsible for the rapid removal of ^{239}Pu from the epilimnion. (auth)

Atmosphere

Refer also to abstracts 26026, 26880, and 28132.

25980 (AAEC/IP-11) PLUTONIUM. Watson, G. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1976. 26p. Dep. NTIS (US Sales Only) $4.00.

Discovery of the neutron made it easy to create elements which do not exist in nature. One of these is plutonium, and its isotope with mass number 239 has nuclear properties which make it both a good fuel for nuclear power reactors and a good explosive for nuclear weapons. Since it was discovered during a war the latter characteristic was put to use, but it is now evident that use of plutonium in a particular kind of nuclear reactor, the fast breeder reactor, will allow the world's resources of uranium to last for millennia as a major source of energy. Plutonium is very radiotoxic, resembling radium in this respect. Therefore the widespread introduction of fast breeder reactors to meet energy demands can be contemplated only after assurances on two points; that adequate control of the radiological hazard resulting from the handling of very large amounts of plutonium can be guaranteed, and that diversion of plutonium to illicit use can be prevented. The problems exist to a lesser degree already, since all types of nuclear reactor produce some plutonium. Some plutonium has already been dispersed in the environment, the bulk of it from atmospheric tests of nuclear weapons.

25981 (AED-CONF-74-725-000 (Vol. 2), pp 570-589) ENVIRONMENTAL GAMMA BACKGROUND RADIATION MEASUREMENTS IN POLAND. Gwiazdowski, B. 1974.

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The natural gamma background radiation, as one of the distinct factors defining the status of natural environment has been measured in certain regions of Poland for several years. Monitoring of the gamma background dose rate level permits the evaluation of population exposure in wide areas of the country by using comparatively simple methods and techniques of measurement. The paper discusses the methods used and the results obtained from the measurements made in Poland by the Dosimetry Department of Central Laboratory for Radiation Protection Warsaw. (DE)

25982 (AED-CONF-74-725-000 (Vol. 2), pp 590-604) NATURAL RADIATION LOAD IN THE FRG. Bonka, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The distribution of the mean natural radiation exposure in the FRG is of the utmost importance for the assessment of the additional population exposure to radionuclides emitted by nuclear facilities. Maps on the cosmic, terrestric, and total natural radiation exposure in the FRG were established on the basis of data on the height dependence of the cosmic radiation exposure and measurements of the terrestric radiation exposure in the FRG published in 1960 by the Niedersaechsisches Landesamt fuer Bodenforschung. These maps are based on an assumed average person spending 80% of the day in buildings and 20% outdoors. A calibration error was found in the measurements of the terrestric radiation exposure by the Niedersaechsisches Landesamt fuer Bodenforschung. After correction, the measured values now agree with the data published by other research groups. The mean cosmic population exposure should be about 33 mrem/a, the mean terrestrial radiation exposure between 50 and 55 mrem/a, and the total natural radiation exposure about 105 mrem/a. (DE)

25983 (AED-CONF-74-725-000 (Vol. 2), pp 615-629) γ-RADIATION EXPOSURE IN THE ENVIRONMENT OF THE KARLSRUHE NUCLEAR RESEARCH CENTRE. Koenig, L. A.; Piesch, E.; Winter, M. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The γ-radiation load due to the influence of the nuclear facilities of the nuclear research centre and to natural radiation was determined using long-term accumulation solid dosemeters and dose rate measuring instruments. For more than six years, a measuring network with a total of 255 stationary points of measurement equipped with phosphate glass and LiF dosemeters has been maintained on and outside the premises of the nuclear research centre. Short-time measurements were made with CaF_2:Dy dosemeters which enable a more exact determination of the exposure dose to be made. The mean natural level of γ-radiation in the environment of Karlsruhe Nuclear Research Centre is 52 ± 3 mR/a. Main sources of the γ-radiation inflicted by the nuclear research centre on its immediate environment are scattered radiation from the radioactive waste store and the γ-radiation of the ^{41}Ar discharged into the atmosphere by the Karlsruhe research reactor FR 2. The scattered radiation from the waste store can still be detected in a distance of some hundred meters. The γ-radiation due to ^{41}Ar emissions from FR 2 has a mean value of 5 mR/a and a maximum value of 20 mR/a along the fence of the nuclear research centre. In a distance of no more than 1 km from the chimney of Fr 2, it is already undetectable except for the main wind directions. (DE)

25984 (AED-CONF-74-725-000 (Vol. 2), pp 691-700) STATIONARY DOSE RATE MEASURING POINTS TO CONTROL THE ENVIRONMENT OF NUCLEAR FACILITIES IN EMERGENCY CASES. Hardt, H. J. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.: Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

A system of stationary control points has been developed for the control of nuclear facilities. These control points are located in the environment of the nuclear facilities and will automatically provide the necessary data on the emission and distribution of radioactive materials in cases of emergency. The demands made on the system are discussed. In addition to this, a network of stationary points of dose rate measurement is currently being established in the FRG for the protection of the general population. It will be possible to call and evaluate these data with the aid of the telephone system of the Federal Postal Administration. The system and the evaluation program are described, and the possibility of joint use for the monitoring of the environment of nuclear facilities in cases of emergency is discussed. (DE)

25985 (BNWL-1971) SNS SOURCE TERM EVALUATION PROGRAM. Craig, D. K.; Cannon, W. C.; Filipy, R. E.; Powers, G. J.; Dionne, P. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-1830. 60p. Dep. NTIS $5.50.

Plutonium-238 is currently used in the form of a pure refractory oxide as a power source on a number of space vehicles that have already been or will be launched during the next few years. Results are reported on aerosol experimental studies, that concern interactions between soils and $^{238}PuO_2$ aerosols which might be created in a space launch abort environment; marine animal studies, which concern support activities for the SNS underwater experiments; ultrafilterability studies, concerns in vitro solubility tests of $^{238}PuO_2$ as a function of time, temperature, suspension concentration, and molality of solvent; and mathematical modeling, which concerns support of the SNS safety effort to standardize analytical techniques for system risk analysis, including the modeling or biological data obtained from inhalation exposure of rodents and dogs to $^{238}PuO_2$ aerosols and comparison of the models to that developed for $^{239}PuO_2$. (CH)

25986 (CONF-7405106-) PROCEEDINGS OF THE SYMPOSIUM ON POWER GENERATION AND AIR QUALITY, MAY 9–10, 1974, RALEIGH, NORTH CAROLINA. (North Carolina State Univ., Raleigh (USA)). 1974. 119p. Univ. of North Carolina, Chapel Hill, NC.

Papers and discussions on air quality and electric power generation are presented. Primary attention is on the nature and effects of pollutants entering the atmosphere from central station power plants. Topic areas include energy needs and source emissions, source emissions and environmental considerations, health effects, ecological effects, control technology and costs, and alternatives and prospects. (auth)

25987 (FRNC-R-38) MONITORING OF RADIOACTIVITY IN 1974. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). [nd]. 68p. (In French). INIS.

Data are presented on the monitoring of the radioactive contamination of air and some foodstuffs at world locations throughout Western South America, South Pacific, Africa, during 1974. Data are included on the total β and γ activity and content of radionuclides found in fallout in air, milk, and other environmental samples (^{131}I, ^{90}Sr, ^{137}Cs). (FR)

25988 (IAEA-169(Vol. 1), pp 3, v.; v. 1 p. 29-50) FISSION PRODUCT NUCLEAR DATA (FPND) AND ENVIRONMENTAL ASPECTS OF NUCLEAR FUEL CYCLE. Iyer, M. R.; Sharma, D. N.; Ganguly, A. K. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The paper reviews the availability and incompleteness of FPND that are important for the evaluation of environmental impact or release of fission products from various operations in the nuclear fuel cycle. The fields where relevance of FPND in environmental investigation and safety are well established are listed. It is emphasized that in every environmental and regional setting the investigator is required to discover for himself the significance of the presence of specific radionuclides in their respective contexts. Possible global environment consequences of fission product releases are indicated as may arise from H-3, Kr-85, unfissioned fissile matter and neutron emission in nuclear explosions and fuel reprocessing. It is observed that data on independent yield in spontaneous fission or fission induced by fast neutrons are mostly not available. There is a dearth of information on radiation from fission products at short times (up to a few seconds) after fission. The data on fission products are mostly better known only for three of four products next to the stable one in the chain. As predicted by a model study, out of a total of 671 fission products in the mass range of 80 to 156, approximately 333 remain to be identified. Dependence of ternary fission yields specially of H-3 on neutron energy is not well established.

25989 (Juel-1220) FUTURE RADIOACTIVE ENVIRONMENTAL POLLUTION IN THE FEDERAL REPUBLIC OF GERMANY BY RADIONUCLIDES FROM NUCLEAR FACILITIES IN NORMAL OPERATION. 1st Report. Bonka, H.; Schulten, R.; Bruessermann, K.; Schwarz, G.; Bieselt, R.; Winske, P.; Brenk, D.; Vogt, K. J.; Darvas, J.; Laser, M. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (F. R. Germany). Lehrstuhl fuer Reaktortechnik). Jul 1975. 234p. (In German). INIS.

Based on important gaseous and liquid radioactive effluents, mainly T, ^{85}Kr, ^{129}I, ^{131}I, and ^{133}Xe, from modern nuclear power plants and corresponding reprocessing plants and on a prediction of the nuclear power plant capacity expansion over a period of approximately 100 years, the future radiation exposure is examined. In the studies the local and regional radiation exposure due to waste air as well as the potential radiation exposure due to liquid effluent into running waters and their use for drinking water purposes are involved. The global effects are dealt with. The results are compared with the variation of the natural radiation exposure of the population in the FRG. There is evidence that the future additional radiation dose will be within the limits of the fluctuation of the natural radiation exposure if it is possible to retain the nuclides T and ^{85}Kr at a rate of about 90% to 99% and iodine at rate of about 99 to 99.8% in the first great reprocessing plants. (DE)

25990 (KFK–2214) PERSISTENCY OF ATMOSPHERIC DIFFUSION CONDITIONS AS A FUNCTION OF THE TIME OF THE DAY. Thomas, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Dec. 1975. 24p. (In German). Dep. NTIS (US Sales Only) $3.50.

The persistency of diffusion conditions (wind direction and diffusion category) is studied at the site of the Karlsruhe Nuclear Research Center as a function of the time of the day. The diffusion category relates to the vertical profile of wind velocity; the wind direction is measured at 60 m height. The persistency is defined here as the probability that the wind direction remains in a given sector longer than the pre-established duration without causing the diffusion category to change by more than a number of stages fixed in advance. Only under unstable and stable weather conditions this persistency depends very much on the time of the day. Varying categories exert a stronger influence on the combined persistency than variations in the wind direction. (auth)

25991 (SAAS–190) RESULTS AND EXPERIENCES FROM ENVIRONMENTAL MONITORING AT RHEINSBERG NUCLEAR POWER PLANT. Ettenhuber, E.; Loennig, M.; Hoffmann, M. L.; Roehnsch, W.; Bebenzien, C.; Lehmann, R.; Schreiter, W. D. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Dec 1975. 74p. (In German). Dep. NTIS (US Sales Only) $4.50.

The paper presents the routine monitoring program at the Rheinsberg nuclear power plant including the methods applied therein. On the basis of data gathered during 1966 to 1973 it is shown that the impact of nuclear power plant operation on the radioactivity level of the examined environmental media was exceedingly small compared to that of global fallout. Therefore, only by means of a system basing on assessment of radiation exposure from effluent data and environmental surveillance it is possible to prove the observance of maximum permissible values to individual members of the public. (auth)

25992 (SCPRI-RM-5-1975) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants, 78–Le Vesinet (France)). May 1975. 11p. (In French). INIS.

This monthly report of the SCPRI exposes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U, and T). A monthly bibliographic selection is also presented. (FR)

25993 (SCPRI-RM-5-1975(App.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details of the Results of Measurements. (Service Central de Protection contre les Rayonnements Ionisants, 78–Le Vesinet (France)). May 1975. 21p. (In French). INIS.

Measurement tables concerning the surveillance of the environment (See also the SCPRI-RM-5-1975 report). (FR)

25994 (SCPRI-RM-6-1975) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants, 78–Le Vesinet (France)). Jun 1975. 14p. (In French). INIS.

This monthly report of the SCPRI exposes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U, and T). A monthly bibliographic selection is also presented. (FR)

25995 (SCPRI-RM-6-1975(App.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details of the Results of Measurements. (Service Central de Protection contre les Rayonnements Ionisants, 78—Le Vesinet (France)). Jun 1975. 24p. (In French). INIS.

Measurement tables concerning the surveillance of the environment (See also the SCPRI-RM-6-1975 report). (FR)

25996 RADIOACTIVITY AND ENVIRONMENTAL PROTECTION. Foldiak, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Izotoptechnika; 18: No. 8, 331-336(Aug 1975). (In Hungarian)

The hazards to the environment of natural radioactive substances, nuclear weapon tests, nuclear power plants, and radioactive waste disposal are discussed. (ERB)

25997 LONG-TERM MEASUREMENTS OF ^{222}Rn, ^{220}Rn, ^{214}Pb, AND ^{212}Pb CONCENTRATIONS IN THE AIR OF PRIVATE AND PUBLIC BUILDINGS AND THEIR DEPENDENCE ON METEOROLOGICAL PARAMETERS. Steinhaeusler, F. (Gastein Research Inst., Austria). Health Phys.; 29: No. 5, 705-713(Nov 1975).

The concentration of ^{222}Rn, ^{220}Rn and their short-lived daughter products were measured simultaneously inside public and private buildings in Innsbruck, Austria. Approximately 750 measurements were carried out with two double-filter devices, a single-filter device and air sampling in specially designed air-bags for a period of almost one year. The buildings were made out of brick, concrete, stone and wood. At all test stations the rooms were not ventilated. The concentration data, together with 24 meteorological variables, were used for a comprehensive regression analysis with a stepwise elimination of variables. It was possible to determine those variables that account for the time variation of radioactivity in the air of a given (nonventilated) room as there are the changes of the barometric pressure, the soil temperature, the daily mean temperature in the open atmosphere, the daily mean wind speed, the relative humidity, and the daily range of the temperature in the open atmosphere and the absolute value of the vertical temperature gradient outdoors. (auth)

25998 TSEZII-137 V BIOSFERE. (Cesium-137 in the Biosphere). Moiseev, A. A.; Ramzaev, P. V. Moscow; Atomizdat (1975). 184p.

Cesium-137, produced as a fission product of heavy nuclei during nuclear explosions or in the operation of nuclear reactors, is a potentially dangerous radionuclide from the viewpoint of radiation safety. The problems connected with introduction of ^{137}Cs into the biosphere are examined. The principal sources for its entry into the external environment, the laws of its migration in the atmosphere, soils, fresh-water streams, and oceans, pathways for the accumulation of ^{137}Cs in the human organism, and the biological consequences of its incorporation are all examined. Special attention is given to the characteristics of the migration of ^{137}Cs along the food chain in some areas of the USSR (particularly the extreme north and the Belorussian-Ukrainian forest region), leading to a very high level of its accumulation in the human body and a very high external dose to the population of these areas. (tr-auth)

25999 ON THE ASSESSMENT OF THE RADIOLOGICAL BURDEN CAUSED BY NUCLEAR POWER STATIONS. Becker, D. E.; Guglhoer, P.; Kotschi, H. (Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (F. R. Germany). Fachbereich Kernenergie und Strahlenschutz). Atomwirtsch., Atomtech.; 20: No. 9, 435-439(Sep 1975). (In German)

5 figs.; 2 tabs.; 11 refs.

The exposure dose in the environment of a nuclear power station caused by the emission of radioactive noble gases through the exhaust stack is determined by the activity and the radiological effectiveness of the mixture released and by meteorological distribution conditions. In principle, these parameters are independent of each other and may be subject to marked seasonal variation. In the absence of detailed measurements of these parameters it has been necessary for purposes of environmental protection so far to postulate a large number of conservative assumptions in calculating the radiological effects. However, the state of the art now permits both the emission and the distribution conditions to be measured at any time in such a way that the true exposure dose can be assessed with an accuracy greater by several orders of magnitude. In this way, the dominating aspects of the protection of the public can be harmonized with those of economical power plant operation on a realistic basis much more efficiently than before, and the duties with respect to information of the public and the execution of exposure studies can be discharged much more accurately. Moreover, important aids have now become available in deciding about protection and emergency measures if activities were to be released as a result of some incident. (DE)

26000 MARINE ORIGIN OF POLONIUM 210 EXCESS IN THE LOWER ANTARCTIC ATMOSPHERE. Lambert, G.; Sanak, J.; Ardouin, B. (Centre National de la Recherche Scientifique, 91-Gif-sur-Yvette (France). Centre des Faibles Radioactivites; CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service d'Electronique Physique). J. Rech. Atmos.; 8: No. 3, 647-648(Jul 1974). (In French).

From international symposium on the chemistry of sea-air particulate exchange processes; Nice, France (4 Oct 1973).

The comparison of the atmospheric concentrations in ^{210}Pb and ^{210}Po shows that the ^{210}Po radioactivity may be higher than that of the ^{210}Pb in strictly oceanic places of the Southern hemisphere. Such an effect is attributed to the ^{210}Po emission from the sea water surface, in agreement with K. K. Turekian hypotheses. (FR)

26001 Rb—Sr, $^{87}Sr/^{86}Sr$ ISOTOPE SYSTEM AS AN INDEX OF PROVENANCE OF CONTINENTAL DUSTS IN THE OPEN ATLANTIC OCEAN. Biscaye, P. E. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory); Chesselet, R. (Centre National de la Recherche Scientifique, 91-Gif-sur-Yvette (France). Centre des Faibles Radioactivites); Prospero, J. M. (Miami Univ., Fla. (USA). Rosenstiel School of Marine and Atmospheric Sciences). J. Rech. Atmos.; 8: No. 3, 819-829(Jul 1974).

From international symposium on the chemistry of sea-air particulate exchange processes; Nice, France (4 Oct 1973).

The Rb—Sr, Sr-isotope system technique was applied to samples of water-insoluble atmospheric dust to test its utility in answering two questions: (1) the continental provenance of the dust, and (2) the relative importance of eolian versus other contributions to deep-sea sediments. Samples of atmospheric dust were taken on Whatman filters during two Atlantic cruises: a north-south section from May to October 1971 (Dakar—Walvis Bay—Azores) and an east-west section from September to October 1972 (Barbados—Dakar). In addition several other filter samples from the Equatorial Atlantic and mesh samples from Barbados were analyzed. The overall pattern of dust concentrations is consistent with the well-known strong Saharan plume at 10 to 15° N latitude and extends westward to the Caribbean with average concentrations in excess of 10 $\mu g/m^3$. The north-south track was relatively near the African coast but permitted some definition of the decrease of dust concentrations north (to about 1 $\mu g/m^3$) and south (to < 1 $\mu g/m^3$) of the main plume. From the $^{87}Sr/^{86}Sr$ ratios we distinguish the dusts from the Saharan and a second plume, probably from the Kalahari Desert of southwestern Africa. The ratios of dusts in the Saharan plume are indistinguishable from deep-sea sediments in this latitude band. Adding Rb/Sr to the Sr-isotope ratios in an isochronous plot, however, permits distinction between the dusts and deep-sea sediments east of the Mid-Atlantic Ridge, and from the sediments underlying the Saharan plume but west of the Ridge. The authors conclude that, west of the Ridge, the colian dust contribution to the sediments is strongly diluted by non-eolian sediment sources, confirming with an independent provenance characteristic conclusions derived from sediment mineralogical data. (FR)

26002 THE FATES OF ^{210}Pb AND ^{210}Po IN THE OCEAN SURFACE. Turekian, K. K.; Kharhar, D. P.; Thomson, J. (Yale Univ., New Haven, Conn. (USA). Dept. of Geology and Geophysics). J. Rech. Atmos.; 8: No. 3, 639-646(Jul 1974).

From international symposium on the chemistry of sea-air particulate exchange processes; Nice, France (4 Oct 1973).

The concentration of ^{210}Pb and ^{210}Po in surface sea water is related to the atmospheric supply rate of ^{210}Pb impressed on the supply from the decay of oceanic ^{226}Ra on the one hand, and the relative removal fluxes of ^{210}Pb and ^{210}Po by particle transport to the deep water on the other. The ^{210}Po ^{210}Pb activity ratio in marine zooplankton reflects the ratio in sea water which in turn reflects productivity. By using published and new values of ^{210}Pb and ^{210}Po concentrations in sea water and the partition coefficient of the ^{210}Po ^{210}Pb ratio between plankton and surface sea water the authors are able to calculate the atmospheric flux of ^{210}Pb at different oceanic sites. The mean residence times of ^{210}Pb and ^{210}Po in the mixed layer have also been calculated for these sites. It is proposed that a significant excess ^{210}Po flux from the ocean surface to the atmosphere may exist. (FR)

26003 TROPOPAUSE ALTITUDE INFLUENCE ON THE OZONE CONCENTRATION AND RADIOACTIVITY VARIATIONS IN THE LOW LAYERS. Rahbar, M. (Teheran Univ. (Iran)). Meteorologie; No. 33, 71-79(Jan 1975). (In French).

Comparison of artificial radioactivity with ozone concentration near the ground at Kerguelen Islands (49° 21'S, 70° 17'E) during the years 1967 and 1968 shows that in most cases an increase of the atmospheric radioactivity is accompanied with an increase in ozone. The probability of this correlation is greater for the

strong increases of radioactivity. Except in few cases, the strong increases of radioactivity always occurred after an important rise of the tropopause. (FR)

26004 ^{238}Pu AND ^{239}Pu CONCENTRATIONS IN THE AIR LAYER CLOSE TO GROUND OF THE PODMOSKOV'E REGION IN 1969–1971. Makhon'ko, K. P.; Bobovnikova, Ts. I.; Volokitin, A. A.; Martynenko, V. P. Sov. At. Energy (Engl. Transl.); 38: No. 4, 322-323(Apr 1975).

Translated from At. Energ.; 38: No. 4, 254-255(Apr 1975).

The ^{238}Pu and ^{239}Pu concentrations in surface air in the Podmoskov'e region were determined for 1969 through 1971. It was found that the average annual ^{239}Pu concentration increased gradually over the period in question. Plutonium-238 quantities were much lower than those of ^{239}Pu and declined slightly over the same period. (ERB)

26005 EVALUATION OF SURFACE ATMOSPHERE CONTAMINATION BY DISCHARGES FROM NUCLEAR POWER STATIONS. Il'in, V. P. Sov. At. Energy (Engl. Transl.); 38: No. 4, 324-325 (Apr 1975).

Translated from At. Energ.; 38: No. 4, 255-256(Apr 1975).

The contamination of the surface layer of the atmosphere by radioactive materials discharged through the ventilation stacks of nuclear power plants is calculated. These estimates are useful in the siting of nuclear power plants. (ERB)

Soil

26006 (DP-MS-75-118) ACTINIDE-SOIL INTERACTIONS IN WASTE MANAGEMENT AT THE SAVANNAH RIVER PLANT. Holcomb, H. P.; Horton, J. H.; Wilhite, E. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1976. Contract AT(07-2)-1. 52p. (CONF-760214–1). Dep. NTIS $4.50.

From conference on actinide sediment reaction; Richland, Washington, United States of America (USA) (10 Feb 1976).

Three aspects of the transuranium (TRU) nuclide-soil interaction were studied in connection with Savannah River Plant (SRP) burial ground operations. Results of the studies are reported as three separate parts of this report. (auth)

Water

Refer also to abstract 25393.

Ecosystems and Food Cycles

Refer also to abstracts 25948 and 26311.

26007 (AED-CONF-74-725-000 (Vol. 2), pp 630-653) RADIATION EXPOSURE TO FALLOUT RADIONUCLIDES. Kistner, G.; Schmier, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

In the statistics on population exposure in the FRG–in terms of the genetically effective dose–the exposure to radionuclides from atomic weapons tests takes the second place. The measured values on which this estimation is based, their calculation and their significance for the total exposure are reported on, and the contribution of the various radionuclides which can be singled out to external and internal radiation exposure is illustrated. It is shown that long-lived radionuclides such as Sr-90 and Cs-137 can still be found in the fallout, and that these nuclides produced during the test series of the sixties still account for most of the internal and external exposure. The content of ^{131}I and other short-lived nuclides in the food chain after the recent French and Chinese nuclear weapons tests is reported on. The importance of the activation products ^{3}H, ^{14}C produced in nuclear explosions is estimated. (DE)

26008 (CEA-N-1820) IN SITU OBSERVATION OF PLUTONIUM TRANSFER PROCESSES IN THE MARINE ENVIRONMENT. Guary, J. C.; Fraizier, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Sep 1975. 19p. (In French). INIS.

A preliminary observation of plutonium transfer processes in the marine environment was carried out and showed that concentration of the radionuclide was lower when marine organisms stood at a higher trophic level. This observation supplemented by an investigation on contamination pathways showed that plutonium was not concentrated along the food chain and its uptake occurred preferentially by direct contact of species with seawater, a process chiefly affecting producers and primary consumers. It appeared that the marine sediment was not a significant vector of plutonium transfer in burrowing species. (FR)

26009 (COO–2447-4) BEHAVIOR OF TECHNETIUM-99 IN SOILS AND PLANTS. Gast, R. G. (Minnesota Univ., St. Paul (USA). Dept. of Soil Science). 1976. Contract AT(11-1)-2447. 43p. Dep. NTIS $4.00.

Work described in this report is aimed at establishing the magnitude and mechanisms of ^{99}Tc sorption by soils and uptake by plants. Studies showed that sorption of ^{99}Tc by soils was essentially stopped by sterilization of the soil, further indicating that the sorption process is related to microbial activity. Studies also showed that sorption can occur under aerobic as well as anerobic conditions. However, there was considerable difference in the extent of sorption for different soils which remains to be explained. ^{99}Tc was shown to be toxic to germinating seeds at low concentrations, but not when added to more mature plants. Initial evidence suggests this is a chemically rather than a radiologically induced toxicity but this remains to be completely resolved as well as whether there is a threshold level of ^{99}Tc required before toxicity occurs. (auth)

26010 DATA ON THE RADIOACTIVE CONTAMINATION OF SOME HUNGARIAN FOODSTUFFS AND MENUS. Szabo, A.; Bende, E. (Megyei Elelmiszerellenorzo es Vegyvizsgalo Intezet, Gyor, Hungary). Izotoptechnika; 18: No. 8, 342-347(Aug 1975). (In Hungarian)

The average activity of artificial radioactive substances incorporated in man by the food chain daily amounts to 100 pCi which is an order of magnitude lower than the activity ratio of K-40. (auth)

26011 EXPERIMENTAL APPROACH TO ^{90}Sr TRANSFER PROCESSES FROM ROCKS TO A TERRESTRIAL MOSS: GRIMMIA ORBICULARIS BRUCH. Hebrard, J. P.; Foulquier, L.; Grauby, A. (Aix-Marseille-1 Univ., 13- Marseille (France); CEA Centre d'Etudes Nucleaires de Cadarache, 13- Saint-Paul-les-Durance (France). Service de Recherches Toxicologiques et Ecologiques). Bull. Soc. Bot. Fr.; 121: No. 7, 235-249(1974). (In French).

Concrete rocks from a mixture of cement, limestone soil, gravel and water were prepared; before drying, the rocks were contaminated with 80 ml of a ^{90}Sr solution at 3.2 μCi/ml. That part of the incorporated radio-element may be transferred from the rocks into water, either by surface leaching or by total immersion of the solid materials. The percentage of activity retained in the water quickly reaches a maximum before decreasing. Following these preliminary observations, colonies of a calcareous terrestrial moss (Grimmia orbicularis Bruch) were implanted in cracks on the surface of the radioactive rocks, and left for two years in a forest clearing on the Cadarache property. The highest activities in the young stalks, as in the older parts of the gametophytes, coincide each year with the moment of maximum rainfall in autumn, winter and spring, seasons during which the bryophytes are constantly moist and when the vegetal activity is at its peak. These values do not remain constant, however, and tend to decrease towards the end of the rainy periods. The quantity of radioelement transferred from the rocks, by leaching or by simple immersion in water, decreased towards the end of laboratory experiments. It may thus be inferred that in nature, inactive rainfall acts as a decontaminating agent in the long run. (FR)

26012 THE USE OF RADIOACTIVE TRACERS IN BIOLOGICAL OCEANOGRAPHY. Amiard, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Union Oceanograph. Fr.; 6: No. 3, 21-25(Sep 1974). (In French).

A review is made of the various applications of radioactive tracers in some fields of biological oceanology such as investigations on metabolisms, pollutions, transfer through food chains, assessment of primary productivity, migrations of marine organisms. Their advantages and drawbacks are shown and illustrated by examples from the most representative foreign and French literature. (FR)

26013 THE USE OF RADIOACTIVE TRACERS IN BIOLOGICAL OCEANOGRAPHY. Amiard, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Union Oceanograph. Fr.; 6: No. 2, 35-40(Jun 1974). (In French)

A review is made of the various applications of radioactive tracers in some fields of biological oceanology such as investigations on metabolisms, pollutions, transfer through food chains,

assessment of primary productivity, migrations of marine organisms. Their advantages and drawbacks are shown and illustrated by examples from the most representative foreign and French literature. (FR)

Radiometric Techniques

Refer also to abstracts 25341, 25349, and 26472.

26014 (BNWL-SA-5421) COMPUTER SYSTEM FOR ENVIRONMENTAL SAMPLE ANALYSIS AND DATA STORAGE AND ANALYSIS. Brauer, F. P.; Fager, J. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 15 Sep 1975. Contract E(45-1)-1830. 24p. (CONF-751116-27). Dep. NTIS $4.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A mini-computer based environmental sample analysis and data storage system has been developed. The system is used for analytical data acquisition, computation, storage of analytical results, and tabulation of selected or derived results for data analysis, interpretation and reporting. This paper discusses the structure, performance and applications of the system. (auth)

26015 (INIS-mf-1754) THE USE OF TRACER TECHNIQUES IN WATER BEARING. Gutierrez R, C. E. (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Ingenieria Quimica e Industrias Extractivas). 1974. 76p. (In Spanish). INIS.

The phenomena occurring in subterranean aquifers are studied using radioisotopic tracers in order to establish approximate models of the behavior of water in these aquifers and to determine the values of its effective porosity so as to best utilize the aquifer water. The methods used were the instantaneous or pulsed injection of radioisotopes. On the basis of the data obtained, both in laboratory experiments and field studies, conclusions were drawn on the residence time of the radioactive solutions and the porosity in the strata of a secondary petroleum recovery field. (JSR)

26016 IRON PODSOL AND IRON-HUMUS PODSOLS: CORRELATION BETWEEN VEGETATION AND VOSGIAN PODSOLS EVOLUTION. Guillet, B. (Centre National de la Recherche Scientifique, 54-Vandoeuvre-les-Nancy (France). Centre de Pedologie Biologique). Rev. Ecol. Biol. Sol; 12: No. 1, 405-414 (1975). (In French)

From meeting on ground ecology; Montpellier, France (30 May 1973).

By pollen analysis of Vosgian podsols, it has been shown that iron-humus podsols have been developed under heather landscape while iron podsols are in steady-state equilibrium with the climax forest. While the iron-humus podsols are younger than iron podsols, the natural ^{14}C measurements give higher apparent ages in Bh horizons. The reason is that the organic matter of iron podsol Bh has a rapid breakdown and therefore "apparent ages" may be looked on as the mean turnover time of the organic matter. By contrast, the organic matter of iron-humus podsol produced by heather litter is more stable, less labile. This organic matter has been accumulated in the Bh horizon without important turnover. (FR)

26017 MICROFLORA AND STRUCTURAL STABILITY OF SOILS. Guckert, A.; Chone, T.; Jacquin, F. (Ecole Nationale Superieure des Industries Agricoles Alimentaires, 91-Massy (France); Institut National Polytechnique, 54-Nancy (France); Centre National de la Recherche Scientifique, 54-Vandoeuvre-les-Nancy (France). Centre de Pedologie Biologique). Rev. Ecol. Biol. Sol; 12: No. 1, 211-223(1975). (In French)

From meeting on ground ecology; Montpellier, France (30 May 1973).

Water stable aggregates produced during the incubation of a loamy soil amended with glucose ^{14}C show a quite differing evolution of their physical properties and their organic matter according to the time of incubation after which they have been isolated from the soil by water sieving. The aggregates, built up during the first week of incubation, therefore during the maximal activity stage of the microflora of the soil, present the highest stability against biodegradation induced by a second incubation process, even if this one has reached six weeks. This evolution of the physical properties of the aggregates, is essentially in relationship with the microbially synthetized organic matter and especially the polysaccharides preferentially incorporated into the humine fraction. This relatively labile microbial humine has a high aggregating effect, the polysaccharide chains forming several bonds between the neighbouring clay surfaces and building up stable structural units. The mechanical strength of these aggregates is related to the stabilization of the humine produced previously and whose evolution towards a relatively stable form seems to be the result of two mechanisms: a secondary biodegradation parallel to a higher humification process of the organic matter and an increase of the bonds between polysaccharides and clay surfaces favoured by the alternating of wetting and drying. (FR)

Site Surveys

Refer also to abstracts 26005 and 28131.

Thermal Effluents

Refer also to abstract 26902.

26018 (COM-75-10300) TERRESTRIAL PHOTOGRAMMETRIC MEASUREMENTS OF SURFACE WATER VELOCITIES. Sea Grant Technical Report No. 3. Loomer, S. A.; Wolf, P. R. (Wisconsin Univ., Madison (USA)). Nov 1974. 17p. (WIS-SG-74-352). NTIS $3.25.

Horizontal surface and subsurface water velocity vectors are parameters necessary for defining mixing zone characteristics of thermal plumes. At the University of Wisconsin-Madison, both aerial and terrestrial photogrammetric techniques have been utilized to measure these water velocity parameters. The techniques are currently being applied to monitor the thermal plumes of the Point Beach nuclear plant on Lake Michigan near Two Rivers, Wisconsin. The paper describes an analytical terrestrial photogrammetric approach which is based upon a single phototheodolite; an approach which assumes a plane lake surface. An error analysis was performed to determine the expected reliability of the results. One unique aspect of the method described herein includes the successful application of a PG-2 Stereoplotter as a mono-comparator. (GRA)

26019 ANALYSIS OF SURFACE SLICKS IN A RESERVOIR RECEIVING HEATED EFFLUENT. Lewis, W. M., Jr. Arch. Hydrobiol.; 74: No. 3, 304-315(Nov 1974).

Large elongate surface slicks are frequently observed on Par Pond, a South Carolina reservoir receiving waste heat. One or more slicks between 50 and 2000 m long and 1 to 50 m wide can be seen on almost any day during the stratification period when the wind strength is between 0.5 and 5.0 m sec^{-1}. Slicks are oriented approximately parallel to the wind and accumulate suspended fragments of macrophytes below the surface as well as debris and organic matter on the surface. An experiment with the surface film indicates that substantially greater amounts of organic compounds are present on the water surface within slicks than outside slicks. Thermal cross section maps demonstrate that slicks are always located above abrupt horizontal temperature discontinuities that ordinarily range between 0.10-0.20°C. Wind driven currents of 4 to 10 cm sec^{-1} converge along the long axis of the slicks and provide the basis for an explanation of the slick phenomenon. Slicks of a similar nature can reasonably be expected on other thermally altered lakes. (auth)

26020 MAN'S INFLUENCE ON THE EARTH HEAT BALANCE. Jacquet, J. Bull. Dir. Etud. Rech., Ser. A; No. 3/4, 5-22(1974).

There is no evidence from present knowledge of significant changes in the Earth-atmosphere heat balance on a planetary scale owing to release of heat energy and modifications of the Earth's atmosphere resulting from human activity. Compared to the natural sources of energy on which the Earth's heat balance depends, heat released and modifications of the balance by human agency amount to very little indeed. Heavily populated areas and major industrial centres, however, may already have caused local climate variations, which may affect wider if certain development predictions are fulfilled. (auth)

26021 NUMERICAL MODEL FOR THERMAL PLUMES AND RIVER DISCHARGES. Paul, J. F.; Lick, W. J. (Case Western Reserve Univ., Cleveland). pp 445-455 of Proceedings of the Seventeenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1974).

From 17th conference on Great Lakes research; Hamilton, Ontario, Canada (12 Aug 1974). See CONF-740813-P1.

A numerical model for the time-dependent, three-dimensional, variable-density flow from a horizontal rectangular discharge into a basin has been developed. Steady-state results are presented for representative flow conditions of the Cuyahoga River entering Lake Erie and of the Point Beach Power Plant thermal discharge into Lake Michigan. Results for three different cases of the Cuyahoga River are given. Two cases are for heated discharges at different flow rates entering a constant depth basin. The lower rate corresponds to flows typical of the late summer months and the higher flow rate corresponds to flows typical of the spring. The third case is for the low flow rate heated discharge entering a variable-depth basin. The depth variation is such that the basin depth doubles in two and one-half river

widths and then remains constant. This depth variation is not realistic for the Cuyahoga River, but it is used to indicate the importance of the variable-depth basin. For the Point Beach thermal discharge calculation, the vertical eddy coefficient is assumed to be a function of the local vertical temperature gradient and the actual bottom topography is used. (auth)

Chemical Effluents

Refer also to abstracts 25342, 25946, 25947, 25949, 25986, and 26097.

26022 (AED-CONF-74-725-000 (Vol. 2), pp 374-383) WATER POLLUTION BY NON-RADIOACTIVE MATERIALS. Dickenbrok, G. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmeatal protection, Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

Water is in constant circulation from the ocean to the earth's atmosphere and back to the ocean. In the course of this cycle, the composition of the water is altered by natural and human influences. Depending on the prevailing conditions, the water may contain solute gases, undissolved substances, inorganic salts, organic compounds, and microorganisms of varying types and concentrations. Many of these substances are known to pollute the water and thus to threaten its various uses. Emitting sources of water pollutants are: waste waters, seepings from open dumpings, mineral fertilizers and biocides washed out from agricultural areas, water pollutants emitted during storage and transport, air pollutants, and erosions from roads. The thermal load is an additional factor. Technical and legal steps are necessary in order to prevent water pollution and to maintain the quality of water required for its various uses. These measures are treated in detail. (DE)

26023 (JUL-1213) ENVIRONMENTAL EFFECTS OF ALTERNATIVE ENERGY POLICIES. A Model Study with Consideration of Sociological Influences. Elsinghorst, D. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Systemforschung und Technologische Entwicklung; Technische Hochschule Aachen (F. R. Germany)). Jun 1975. 144p. (In German). INIS.

66 figs.; 14 tabs.; 106 refs.

The exponential increase of the energy consumption has reduced the possibility to pollute air and land so much that the detrimental external effects of economic activities must be regarded in energy modelling. That means to analyze the interdependent connections between the economic system and the environment and to picture the structure of the real system on a mathematical model. To do this, System Dynamics models were developed. Besides the relevant technical variables, sociological variables such as "public pressure" or "lobby pressure" were regarded. So it was possible to break open the "ceteris paribus" assumption of the constant sociological and political influences. The environmental effect of various policies to meet the energy demand was critically examined in simulation runs. It was demonstrated that the pollution of the atmosphere will decrease in the beginning of the 80's. This is based on the implementation of a new energy technology with a lower pollution and, on the other side, on the increasing amount of pollution control. (DE)

26024 (LA-6103) MONTE CARLO SIMULATION OF THE TURBULENT TRANSPORT OF AIRBORNE CONTAMINANTS. Watson, C. W.; Barr, S. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-Eng-36. 28p. Dep. NTIS $4.00.

A generalized, three-dimensional Monte Carlo model and computer code (SPOOR) are described for simulating atmospheric transport and dispersal of small pollutant clouds. A cloud is represented by a large number of particles that we track by statistically sampling simulated wind and turbulence fields. These fields are based on generalized wind data for large-scale flow and turbulent energy spectra for the micro- and mesoscales. The large-scale field can be input from a climatological data base, or by means of real-time analyses, or from a separate, subjectively defined data base. We introduce the micro- and mesoscale wind fluctuations through a power spectral density, to include effects from a broad spectrum of turbulent-energy scales. The role of turbulence is simulated in both meander and dispersal. Complex flow fields and time-dependent diffusion rates are accounted for naturally, and shear effects are simulated automatically in the ensemble of particle trajectories. An important adjunct has been the development of computer-graphics displays. These include two- and three-dimensional (perspective) snapshots and color motion pictures of particle ensembles, plus running displays of differential and integral cloud characteristics. The model's versatility makes it a valuable atmospheric research tool that we can adapt easily into broader, multicomponent systems-analysis codes. Removal, transformation, dry or wet deposition, and resuspension of contaminant particles can be readily included. (auth)

26025 (PB-231665-28) SUMMARIES OF FOREIGN GOVERNMENT ENVIRONMENTAL REPORTS. (Environmental Protection Agency, Washington, D. C. (USA)). Dec 1974. 57p. NTIS $4.25.

Paper copy also available on subscription, $35.00/year domestic, $45.00/year foreign.

This is a monthly announcement listing of foreign documents received through exchange agreements between EPA and various foreign countries. This series, devoted to summaries of government reports and other pertinent literature and focusing on the legislative, organizational, economic, and social aspects of environmental protection, supplements foreign scientific and technical literature abstracted by other EPA information services. (GRA)

26026 AFRICAN AND MARINE CONTRIBUTIONS TO SULFATE AEROSOLS OF SOUTHERN HEMISPHERE. Nguyen Ba Cuong; Bonsang, B.; Pasquier, J. L.; Lambert, G. (Centre National de la Recherche Scientifique, 91-Gif-sur-Yvette (France). Centre des Faibles Radioactivites; CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service d'Electronique Physique). J. Rech. Atmos.; 8: No. 3, 831-844(Jul 1974). (In French)

From international symposium on the chemistry of sea-air particulate exchange processes; Nice, France (4 Oct 1973).

From 1971 to 1973, during Gallieni and Marion Dufresne cruises relieving the scientific teams in the French Austral and Antarctic stations, systematic measurements of radon-222, sulfate aerosols, and sulfur dioxide (SO_2) atmospheric concentrations were made, carefully avoiding contaminations by ships exhausts. At sea level, South of 35°S, concentrations of sulfates are 1 $\mu g\ m^{-3}$. Bearing in mind the long distances from continental coasts and our data showing aerosols very short life-time in these areas, this value is only explainable if the marine source for aerosols is taken into account. Northward, between 5° and 25°S, the easterly circulation pattern requires to distinguish between the eastern and western African areas. Over the Indian Ocean, little higher sulfates concentration (1.3 $\mu g\ m^{-3}$) also characterizes an aerosol marine source, when we refer to the very low radon concentrations we observe. Over the Atlantic, radon concentrations ten times higher are related to sulphate concentrations greater than 2 $\mu g\ m^{-3}$, which are, for one half, from continental origin. The SO_2 measurements support our interpretation of the data. (FR)

26027 REGULATING THE DEGREE OF RADIOLOGICAL PROTECTION IN WORK INVOLVING NATURALLY RADIOACTIVE SUBSTANCES IN THE RARE METALS INDUSTRY. Lyarskii, P. P.; Elovskaya, L. T.; Kapitanov, Yu. T.; Denisov, A. F. Gig. Sanit.; No. 9, 34-38(Sep 1974). (In Russian).

A summary is given on research conducted in the USSR to determine the pathogenic role of the radioactivity of industrial dusts in the development of pneumoconiosis, the permissible concentration of natural radionuclides in thorium and uranium ores, and the permissible level of atmospheric pollution by thorium. A classification by degree of hazard for work involving exposure to ionizing radiation during the enrichment and reduction of ores of zirconium and niobium (loparite) is presented in tabular form. (CIS Abstr. Vol. 2)

INSTRUMENTATION

Radiation Detection Instruments

26028 (EUR-5397e, pp 143-149) STANDARDIZATION OF RADIATION PROTECTION INSTRUMENTS: HOW MUCH IN NEED, HOW FAR TO CARRY? Maushart, R. (BF-Vertriebs-GmbH fuer Messtechnik, Karlsruhe, Ger.). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Some topics discussed are: organizations specialized for standardization; need for international exchangeability; objectives of standardization; personnel dosimetry; operational requirements; training of the instrument user; the view of the radiation protection officer; the view of the instrument manufacturer; and the view of the concerned citizen. (HLW)

General Detectors and Monitors

Refer also to abstracts 25394, 25936, 26082, 26337, 26338, 26343, 27050, 27168, 27210, 27731, and 28191.

26029 (AD/A-008149) LEAD SHIELD TO IMPROVE DETECTION OF HIGH-ENERGY PHOTONS OF 38 keV AND 42 keV BY SCINTILLATION CAMERAS. Technical Note. Stevenson, J. S. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Oct 1974. 16p. (AFRRI-TN-74-9). NTIS $3.25.

A lead shield was designed and tested for use with the pinhole collimator of the Nuclear-Chicago HP scintillation camera to detect photons of 38 K and 42 K for cardiac scanning. A discussion of each isotope with reference to cardiac scanning is given with special emphasis on the problems of imaging high-energy photons, i.e., 511 keV or higher with the presently available scintillation cameras. (GRA)

26030 (AED-CONF-74-725-000 (Vol. 2), pp 654-661) INTEGRATING DOSEMETERS TO CONTROL THE ENVIRONMENTAL RADIATION EXPOSURE. Becker, K. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The demands made on the sensitivity, exactness and stability of cheap integrating detectors for long-term monitoring of the environment are considerably higher than those made on the traditional personnel dosemeters. Some of the main tasks during work in this field at Oak Ridge therefore involved: (1) the thorough testing of the more familiar TL materials under laboratory and also under practical conditions (including countries with high temperatures); (2) the development of new materials and methods with improved characteristics on the basis of TLD and TSEE; and (3) a critical evaluation of the various methods in comparative international studies. The author reports on recent findings in these fields as well as on studies for the experimental determination of the mean environmental dose over centuries and millenia. (DE)

26031 (CEA-CONF-3136) NUCLEAR TRACK MEASUREMENT USING A SEMIAUTOMATIC DEVICE. Application to Neutron Spectrometry With Low and Mean Energy Accelerators. Delsaut, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 -- Gif-sur-Yvette (France). Service de Protection contre les Rayonnements). 1975. 19p. (In French). INIS.

From 9th congress on the control of ionizing radiation; Grenoble, France (15 Apr 1975).

Attempts for improving the emulsion technique used in neutron spectrometry near accelerators are presented. The two difficulties involved in the method consist in the long time duration and tedious aspect of emulsion scanning, and the absence of preferential direction for the neutrons measured in the vicinity of the accelerators. In view of solving these difficulties, a semi-automatic device of emulsion scanning, whose results are directly usable by a computer was used and the fixed emulsion replaced by a movable set of two perpendicular emulsions. The validity of the method was checked by measuring the neutron spectrum emitted from the D (d,n) ^{3}He reaction. (FR)

26032 (CRN-HE-75-8) AUTOMATIC GAIN SURVEY ON SCINTILLATION COUNTERS USED TO MEASURE PARTICLES ENERGY LOSS. Callot, O.; Meyer, J. M. (Centre National de la Recherche Scientifique, 67 -- Strasbourg (France). Centre de Recherches Nucleaires). 1975. 18p. (In French). INIS.

An automatic gain survey has been performed on 32 scintillation counters used to measure particle energy loss. Depending on the beam intensity, sizable variations in the photomultiplier gain have been measured. The control system allowed the study of these variations as a function of time. (FR)

26033 (EUR-5397e, pp 268-274) DESIGN OF THE NEW GENERATION OF MATERIALS FOR DETECTION OF CRITICALITY ACCIDENTS. Renard, C.; Prigent, R. (CEA, Fontenay-aux-Roses, France). 1975. (In French).

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The concepts used in the design of detection networks presently in use are tabulated and the two techniques for the detection of criticality, the use of gamma probes or neutron probes sensitive to the threshold level 10^{15} fissions, are briefly examined. The new philosophy developed in France on the basis of a number of criticality studies is discussed and the two primary conclusions reached are that it is impossible to define a characteristic minimum accident and it is impossible to define a dose-fission ratio. Therefore the basis on which a criticality detector should be developed is that of the accidental dose limit, which is a mixture of neutron and gamma rays released during the excursion. The detector developed is composed of a plastic scintillator sensitive primarily to gamma rays, a boron scintillator sensitive to thermal neutrons, and a photoemission cell. These are placed within a polyethylene housing to thermalize the fast neutrons. The principal characteristics of the detector are outlined.

26034 (FRNC-TH-562) CONTRIBUTION TO THE STUDY OF A STRUCTURE FOR AMPLIFYING AND LOCATING PHOTOELECTRONS USING JOINTLY A VACUUM TUBE AND A SEMICONDUCTOR TARGET. Vaz de Mello, F. L. (Grenoble-1 Univ., 38 (France)). 1975. 130p. (In French). INIS.

The problem of scintigraphic cameras is raised and a new unconventional system is described, especially designed for medical scintigraphy. A detailed bibliographical study is devoted to the various physical phenomena involved in the operation of the planned camera. Its two main elements, the photoelectron concentration system and the detection targets for these electrons, are studied with a view to their construction. The bibliographical study is supplemented by an inventory of various other prospective ideas for improving the efficiency of the instrument (polycrystalline layers, electron emitter by lowering the output potential, amplifying detection targets etc...). The study and development of the photoelectron focussing system led to a device which can be used on the camera. The development of post-acceleration photoelectron detection targets also led to a diode technology perfectly adaptable to the instrument. (FR)

26035 (FRNC-TH-575) DEFINITION, ACQUISITION AND PROCESSING OF THE DATA ISSUED FROM A DETECTOR SET FOR WIRE CHAMBERS. Millaud, J. (Paris-11 Univ., 91 -- Orsay (France)). 1975. 175p. (In French). INIS.

The experimental room HE1 of the Saclay accelerator LA 300 is given over to experiments on elastic and inelastic electron scattering. It is equipped with two magnetic spectrometers for the pulse analysis of scattered or coincident particles. The choice made for particle detection and data processing on the basis of the working conditions imposed is explained. The first detection experiments with the apparatus in the spectrometer 900 were carried out in July 1973. The full spectrometer equipment has been operational since the end of the same year. The problem raised by the introduction of a real-time computer in the detection and data acquisition system were not only the logistic one but also the need to compromise between desirable output and maximum rate of acquisition of nuclear events. Methods of data extraction from filament chambers progressed considerably during the whole period of development of the system as far as spatial resolution and simplicity of electronic equipment are concerned. Electronic technology now offers possibilities in-

comparably greater than those available at the time of the decision. (FR)

26036 (FRNC-TH-579) CONTRIBUTION TO THE IMPROVEMENT OF THE INTELLIGIBILITY ON SCINTIGRAPHIC IMAGES. Cordier, S. (Lyon-1 Univ., 69 (France)). 1975. 179p. (In French). INIS.

First of all the physical conditions necessary to obtain the image of a radioactivated organ are defined, after which the characteristics of these images are analyzed in order to suggest a suitable treatment for each type of degradation. The relationships between the different parameters of the system: object to be detected, noise in the measurement, pulse response of the system etc... are expressed in mathematical formulae. It is shown that the detection system as a whole may be considered with a very good approximation as a linear filter and the generality of this approach enables it to be applied to any imagery system. Since in morphological examinations an abnormal relief is looked for in the representation of an organ the use of digital computing methods was considered as a means of showing up these reliefs from a previously restored image and the information processing aspect of the problem is considered. The generalization of two-dimensional positive unfolding is not utopian and it is found that the number of calculations to be performed is only proportional to n even when an (nxn) image is obtained. (FR)

26037 (JINR-R-13-8188) DESIGN AND CHARACTERISTICS OF A 900 × 300 mm^2 PROPORTIONAL CHAMBER. Astabatyan, R. A.; Zanevskij, Yu. V.; Novikov, E. A.; Peshekhonov, V. D.; Ural'skij, D. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 11p. (In Russian). INIS.

3 refs.; 7 figs.

A description is given of the construction of single-coordinate, proportional chambers having a working area of 900 × 300 mm^2. A presentation is given of the working characteristics obtained by means of a beta source under laboratory conditions. (tr-auth)

26038 (K-1882) EVALUATION OF A 4 pi NEUTRON COUNTER FOR THE NONDESTRUCTIVE ANALYSIS OF URANIUM-234 IN URANIUM HEXAFLUORIDE. Mullins, W. T. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Feb 1976. Contract W-7405-eng- 26. 15p. Dep. NTIS $8.50.

A neutron counter has been evaluated for the nondestructive analysis of ^{234}U in uranium hexafluoride. The instrument was designed by Los Alamos Scientific Laboratory for the Nuclear Safeguards Program. The method assumes that the only source of neutrons is from ^{19}F(alpha, n)^{22}Na reaction from ^{238}U, ^{235}U, and ^{234}U, the yield from ^{234}U being the most abundant. This evaluation shows that the mean of the difference between the 4 pi neutron counting method and mass spectrometry is 0.0002 wt percent uranium-234 +- 0.00015 at the 95 percent confidence level. However, the presence of ^{232}U produces significant errors in the system. If the neutron technique is to be used for samples containing ^{232}U in equilibrium with its daughters, the 2.61-MeV gamma peak of ^{208}Tl must be measured and used to correct for the ^{232}U. It has been postulated that the neutron counter might also be used to relate the ^{234}U content of a sample to the ^{235}U, thus estimating the ^{235}U concentration. This evaluation notes, however, that in a variety of uranium feeds and enriched product, the ^{234}U/^{235}U ratio varies too widely to enable a valid ^{235}U determination.

26039 (UCSD-34P220X2) ROLE OF SECONDARY PARTICLES IN THE IONIZATION PROCESS. Progress Report, January 1–December 31, 1975. Baily, N. A. (California Univ., San Francisco (USA). Dept. of Radiology). 1975. Contract E(04-3)-34. 19p. Dep. NTIS $3.50.

Work over the past year on testing and improvement of the multiwire proportional chamber is reviewed. Accomplishments include a reduced absolute noise level, a study on the counting rate, measurement of resolution, improved preamplifier performance, acquired more preliminary data using alpha particles, calculated the gas gain vs pressure and high voltage, investigated the performance of the MWPC at low pressures (approximately 1 torr), and made changes in wire spacing and the spacing between planes to optimize the relationship between gas gain and particle pathlength. Preparations for machine runs at UCLA and Berkeley are summarized. (WHK)

26040 CdTe SUB-MINIATURE SEMI-CONDUCTOR DETECTOR: A VERSATILE INSTRUMENT FOR DETECTION OF γ RADIATION. Neyer, E. (Neurological Hospital, Montreal); Desaulniers, G.; Sternberg, J. Int. J. Appl. Radiat. Isot.; 26: No. 11, 697-702(Nov 1975).

Details of a subminiature CdTe probe, used for γ detection and determination in clinical applications, are given. The small size and excellent energy resolution of such a solid state detector offer great advantages. The optimum sensitivity of the probes tested ranged between 35 and 80 keV and the resolution averaged 1 to 2 mm. The probe gave excellent results in the assay of ^{125}I and reasonably good results in the determination of ^{99m}Tc. It has been used for in vivo uptake measurements in small animals, such as the thyroid uptake of ^{125}I in intact mouse and for scanning of tissue slides, as a rapid alternative for auto-radiography. The addition of a Pb-collimator results in a stimulation of Pb x-ray fluorescence, producing a significant increase of the count rate. (UK)

26041 DETECTION OF ENERGETIC LIGHT CHARGED PARTICLES BY SOLID STATE NUCLEAR TRACK DETECTORS. Khan, H. A.; Yameen, S.; Atta, M. A.; Haroon, M. R. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). Radiat. Eff.; 26: No. 3, 177-180(Oct 1975).

Experiments have been carried out to detect ^{3}He particles and protons having energies up to 10 MeV/nucleon by using Kodak CA80-15, cellulose nitrate plastic track detector. Various etching conditions were tried in order to develop tracks for the whole of the energy range considered. Detailed analysis seems to indicate that at high energies, the tracks are mainly produced by "secondaries" (elastically scattered nuclei of C, N, O and H, and other reaction products) while in the low energy region, the slowed down "primaries" play the dominant role. The prolonged etching factors of these detectors for different types of tracks have also been obtained and used to derive their average etchable ranges in the materials concerned. (auth)

26042 ION DISTRIBUTIONS IN PLANE AND CYLINDRICAL CHAMBERS. Rosen, R.; George, E. P. (New South Wales Univ., Kensington, Australia). High Temp.–High Pressures; 20: No. 6, 990-1002(Nov 1975).

The ion chamber equations of Thomson include both ion recombination and space-charge terms. Neglecting the space-charge term, an exact solution is obtained for the ion densities across a plane ionization chamber. The method has been extended to the cylindrical chamber, and examples are given of the expected ion distributions in both geometries. Current-voltage relationships were derived for both chambers and compared with those of other workers. If the space-charge term was retained, the ion chamber equations for both geometries were not soluble in closed form. The cylindrical chamber was considered and a computer solution was obtained for the ion distributions and current. Comparison with the non-space-charge solution showed that while there was only a small difference in the current-voltage relationship, a significant difference could occur in the ion concentrations. (auth)

26043 VARIATION OF ACTA SCANNER NUMBERS WITH THE PHYSICAL PROPERTIES OF THE SCANNED MATERIAL. Kiker, W.E.; Hinz, T.W. (Radiological Physics Division, Armed Forces Radiobiology Research Institute, Bethesda, Maryland 20014); Ledley, R.S. Med. Phys. 3: No. 1, 42-44 (Jan 1976).

An experiment has been carried out in which an ACTA computerized axial-transverse tomographic scanner was used in a series of scans on a polystyrene phantom. Cavities in the phantom contained distilled water and various concentrations of acetic acid or ferric nitrate in aqueous solution. It is shown that the ACTA numbers generated for the low-Z acetic acid solution are proportional to the electron density of the solution, but that such is not the case for the higher-Z ferric nitrate, where photoelectric absorption is significant. The correlation of scanner numbers with electron density rather than with mass density is discussed and, as an illustrative example, the electron densities of whole blood and blood cells are calculated and the relative value is compared with the relative mass densities of the materials. (auth)

26044 WINDOW FOR RADIATION DETECTORS AND THE LIKE. Sparks, C. J. Jr.; Ogle, J. C. (to U.S. Energy Research and Development Administration). US Patent 3,916,200. H01J39/26. 28 Oct 1975. Filed date 4 Sep 1974. 4p.

PAT-APPL-503,121.

An improved x- and gamma-radiation and particle transparent window for the environment-controlling enclosure of various types of radiation and particle detectors is provided by a special graphite foil of a thickness of from about 0.1 to 1 mil. The graphite must have very parallel hexagonal planes with a mosaic spread no greater than 5° to have the necessary strength in thin sections to support one atmosphere or more of pressure. Such graphite is formed by hot-pressing and annealing pyrolytically deposited graphite and thereafter stripping off layers of sufficient thickness to form the window.

26045 METHOD OF PRODUCING THIN CELLULOSE NITRATE FILM. Lupica, S. B. (to U.S. Energy Research and Development Administration). US Patent 3,928,700. B32B7/02; C08L1/18; G01T1/02. 23 Dec 1975. Filed date 30 May 1974. 4p.

PAT-APPL-474,554.

An improved method for forming a thin nitrocellulose film of reproducible thickness is described. The film is a cellulose nitrate film, 10 to 20 microns in thickness, cast from a solution of cellulose nitrate in tetrahydrofuran, said solution containing from 7 to 15 percent, by weight, of dioctyl phthalate, said cellulose nitrate having a nitrogen content of from 10 to 13 percent.

26046 X-RAY IMAGE INTENSIFIER PHOSPHOR. D'Silliva, A. P.; Fassel, V. A. (to U.S. Energy Research and Development Administration). US Patent 3,925,674. G01D15/14. 9 Dec 1975. Filed date 30 Jan 1973. 4p.

PAT-APPL-327,899.

Y/sub 1-x/Gd/sub x/·PO_4:Tb^{3+} is an effective phosphor for use in X-ray intensifier screens and in nuclear radiation detection systems.

26047 BACKGROUND COMPENSATION FOR A RADIATION LEVEL MONITOR. Keefe, D. J. (to U.S. Energy Research and Development Administration). US Patent 3,924,106. G06M3/14; G01T1/00. 2 Dec 1975. Filed date 31 Oct 1974. 6p.

PAT-APPL-519,491.

Background compensation in a device such as a hand and foot monitor is provided by digital means using a scaler. With no radiation level test initiated, a scaler is down-counted from zero according to the background measured. With a radiation level test initiated, the scaler is up-counted from the previous down-count position according to the radiation emitted from the monitored object and an alarm is generated if, with the scaler having crossed zero in the positive going direction, a particular number is exceeded in a specific time period after initiation of the test. If the test is initiated while the scale is down-counting, the background count from the previous down-count stored in a memory is used as the initial starting point for the up-count.

26048 ASPECTS OF INTERACTION OF β-RADIATION WITH NUCLEAR PHOTOGRAPHIC EMULSION. Belous, V. M.; Kartuzhanski, A. L.; Kehva, T. E.; Martysh, G. G.; Plachenov, B. T.; Shur, L. I. ATOMKI (At. Kut. Intez.) Kozl.; 17: No. 3, 287-291 (1975).

From 8th symposium on autoradiography; Visegard, Hungary (5 May 1975).

In a great majority of cases autoradiography deals with β-emitting isotopes. Various factors influencing the sensitivity of nuclear and other photographic emulsions to β-radiation are studied. Two aspects of β-particles interaction with emulsion are discussed: (1) the existence of channels other than latent image formation, for utilization of electrons generated by β-particles in AgHal, and (2) β-radiation energy storage in gelatine and its subsequent transfer to AgHal. (WHK)

26049 RELATIVE EFFICIENCY OF THE 100 cm^3 Ge(Li) DETECTOR OF ATOMKI. Somorjai, E. (Atomki, Debrecen, Hungary). ATOMKI (At. Kut. Intez.) Kozl.; 17: No. 3, 239-247 (1975). (In Hungarian)

The relative full-energy peak efficiency of a 100 cm^3 Ge(Li) gamma ray detector has been measured from 1 to 12 MeV. The measurement was performed by a ^{56}Co radioactive source and γ ray cascades following (p,γ) capture reactions. The estimated average accuracy of the relative efficiency obtained is about 5 to 10%. The efficiency ratios of the full-energy peak and the double-escape peak as well as those of the single-escape peak and the double-escape peak have also been determined. The last ratio proved to be independent of the energy. (auth)

26050 OPTIMIZATION OF COLLIMATOR PARAMETERS FOR GAMMA-CHAMBER. Lifshits, V. B.; Sirota, S. M.; Kostylev, V. A. (Scientific-Research Inst. of Neurosurgery, Moscow). Med. Radiol.; 21: No. 1, 41-45(Jan 1976). (In Russian).

The article is devoted to the problem of developing a method of calculation of a collimator device for a gamma chamber. A new criterion of the quality of the system was made up with the help of which it was possible to optimize the chamber collimator. Analytical expressions of the criteria are given. A new conception of the object of detection is presented. This conception is the function of distribution of not only the radioactive material density but also of the time of exposure. (auth)

26051 STATISTICAL FLUCTUATIONS OF THE READINGS OF A DETECTOR IN A FIELD RADIATION. Kol'chuzhkin, A. M.; Uchaikin, V. V. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 90-96(1975). (In Russian).

The passage of particles through matter is a random process, and therefore, the readings of a detector registering the radiation are random. This study derives the equations for the probability characteristics of the readings of a detector, and establishes the connection between these characteristics and average values, for the calculation of which it is possible to use ordinary diffusion theory. (SJR)

26052 IDENTIFICATION OF NUCLEAR PARTICLES. Goulding, F. S.; Harvey, B. G. (Univ. of California, Berkeley). Annu. Rev. Nucl. Sci.; 25: 167-240(1975).

Identification by absorption in a detector telescope, time-of-flight identifiers, and systems involving magnetic rigidity are discussed. 168 references. (WHK)

Radiation Dosimeters

Refer also to abstract 26115.

26053 (AD/A-006678) THERMALLY STIMULATED CURRENT DOSIMETRY. Final Report, 10 Apr 73-30 Jun 74. Gates, D. C.; Krehl, P.; Magee, T. J.; Armistead, R. A. (Stanford Research Inst., Menlo Park, Calif. (USA)). 24 Jan 1975. Contract DNA001-73-C-0252. 47p. NTIS $3.75.

This report describes an experimental program to develop a radiation dosimeter system based upon the measurement of thermally stimulated conductivity (TSC) in dielectric materials. These materials spanned a broad range of atomic numbers and included MgF_2, SiO_2, CaF_2, CaF_2:Dy, SrF_2, Y_2O_3:ThO_2, $LiNbO_3$, BaF_2, HfO_2, Ta_2O_5, ThO_2, ThO_2:CaO, Mylar and Lucite. The TSC of materials exposed to ^{60}Co gamma radiation was measured during heating at linear rates to a maximum temperature of 450°C. Prominent TSC peaks were observed with ThO_2, Y_2O_3:ThO_2, and the plastics. The authors believe that the desirable dosimeter qualities of reusability and reproducibility can be attained with carefully fabricated doped crystals or with mixed polycrystals that are annealed near their melting temperatures. (GRA)

26054 (AD/A-008317) TEST MODELS OF TACTICAL DOSIMETERS IM185 AND IM188. Research and Development Technical Report. Kronenberg, S. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Mar 1975. 28p. (ECOM-4298). NTIS $3.75.

Tactical Dosimeters IM185 (Army version) and IM188 (Air Force version) are used to measure total doses of gamma rays and fast neutrons delivered at low rates as well as at extremely high rates, which correspond to the radiation from fallout and the prompt initial radiation from tactical nuclear weapons, respectively. This report describes techniques developed to alleviate the difficulties encountered in the use and maintenance of previous test models. (GRA)

26055 (AED-CONF-74-725-000 (Vol. 2), pp 662-690) THE IMPROVED SCINTILLATION DOSEMETER PTB 7201. Kolb, W.; Lauterbach, U. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

A dosemeter developed in the Physikalisch-Technische Bundesanstalt was used by all measuring institutes under the BMI project "Determination of the present population exposure in living rooms and lounges". The design and mode of action of this dosemeter are described with special regard to some improvements made in the sensitivity to cosmic radiation and in the temperature response. The article concludes by indicating further possible applications. (DE)

26056 (GSF-K-75, pp v) DOSE DETERMINATION USING THE IONIZATION METHOD. Pohlit, W. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

In addition to explanations on the fundamentals of the dosimetry of ionizing radiation, the relationship between kerma and the exposure or standard ionic dose and the corresponding unit-fluoroscopy is given, and the measurement using a standard measuring equipment is described. The requirement for secondary particle equilibrium and necessary correction factors is gone into in detail. The application of the ionization method to determine the energy dose with extrapolation ionization chambers and the application of secondary standards to calibrate the thimble chambers are discussed. Also, the perturbing effects are dealt with in detail. (DE)

26057 (GSF-K-75, pp v) CHEMICAL DOSIMETRY OF WEAKLY IONIZING RADIATION. Frankenberg, D. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Following an explanation of the radiochemical mechanism of the iron sulphate dosimeter as a chemical dosimeter, the determination of the energy dose in water is described. Furthermore, data on the application region, measuring method and accuracy in determining the energy dose are given. Finally, the practical performance of the iron sulphate dosimetry is discussed where the extreme caution needed to avoid error sources is particularly indicated. (DE)

26058 (GSF-K-75, pp v) FILM DOSIMETRY. Markus, B. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

The fundamentals and essential aspects of film dosimetry are presented. Starting with the silver nucleus formation in the emulsions by photo-ionization, the dependence of the blackening on the type of radiation and energy as well as on the time distribution of exposure and thus also of the dose power is discussed. The introduction of the hardness factor is thoroughly explained in photon radiation and complications are indicated which arise in the application of film dosimetry within a phantom by changing of the photon spectrum. The directional effect is more important in electron dosimetry. The application as a neutron dosimeter is touched upon, and the filter analysis is dealt with which is particularly used in personnel dosimetry to determine the spectral composition of the radiation. (DE)

26059 (GSF-K-75, pp v) THERMOLUMINESCENCE DOSIMETRY. Regulla, D. F. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Thermoluminescence dosimetry is an important aid in assessing radiation intensity even under extreme conditions. It is, however, mainly suited for relative dose measurements only. To determine absolute doses, the thermoluminescence dosemeter has to be attached to a calibration dosemeter. The measured quantity is determined by the calibration dosemeter. The main problem of thermoluminescence dosimetry is the susceptibility of these dosemeters to errors of measurement most of which are due to solid-state physical phenomena. Knowledge of these phenomena and minimization of their influence should help to achieve the accuracy of ±5% which will make thermoluminescence dosemeters suitable for medical use. (DE)

26060 HIGH-RESOLUTION DOSIMETRY WITH STIMULATED PHOSPHORESCENCE. Bjärngard, B.E.; Chen, G.T.Y.; Maddox, B.J. (Joint Center for Radiation Therapy and Department of Radiation Therapy, Harvard Medical School, Boston, Massachusetts 02115). Med. Phys. 3: No. 1, 39-41 (Jan 1976).

Thermally stimulated radiophosphorescence has been studied as a means of high-resolution dosimetry. Small grains of $CaSO_4$:Mn phosphor, embedded in a thin Teflon tape, constitute the dosimeter. The light emitted after irradiation is measured with a photomultiplier coupled to the eyepiece of a scanning microscope. With $CaSO_4$:Mn, the phosphoresence at room temperature is sufficient for measurement after doses in excess of 3000 rads. The spatial resolution of the technique is about 0.2 mm. The method has been tested by measuring the dose distributions from a radium needle and a β-emitting eye applicator. (auth)

26061 CHARACTERISTICS OF WALL-LESS COUNTERS FOR MICRODOSIMETRY. Farnakeev, V. V.; Videnskii, V. G. pp 94-96 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow: Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124--.

A wall-less cylindrical counter was developed and constructed. Its volt-amp characteristics were determined. The apparatus spectrum during irradiation of the counter with a non-collimated beam of α particles was measured. The scheme for the determination of the dimensions of the sensitive volume of the counter in the horizontal plane is shown. (JSR)

26062 A GRAPHITIC DOUBLE-EXTRAPOLATION-CHAMBER FREE OF POLARITY EFFECTS DESIGNED FOR ABSOLUTE DOSIMETRY OF HIGH-ENERGY ELECTRONS. Markus, B. (Goettingen Univ. (F. R. Germany). Abt. Elektronenschleuder; Goettingen Univ. (F. R. Germany). Abt. fuer Strahlenphysik und Strahlenbiologie). Strahlentherapie; 150: No. 3, 307-320(Sep 1975). (In German)

9 figs.; 3 tabs.; 24 refs.

Theoretical principles, constructional features and operation of an improved extrapolation chamber intended for absolute ionization dosimetry of high-energy electrons are described. The construction allows a precise variation of the cylindrical measuring volume by varying thickness and diameter (exactly from 0 to 30 or 3 to 30 mm resp.), whereat measurements can be taken either using cylindrical graphitic walls or "no walls." The improvements consist in a combination of the following characteristics: high electric and mechanical stability; avoidance of disturbances due to electrostatic charges; elimination of the polarity error; practically homogeneous graphitic construction without foreign materials; graphite as a preferential reference material; measurements by chemical dosimetry following within the same apparatus. Results of measurements are reported concerning the verification of the complete or partial equilibrium of electrons, the deviations from the ideal cavity conditions of Bragg and Gray, and the comparison with ferrous sulfate dosimetry. Absolute measurements of the ion dose being accurate to about 0.5% can be obtained with the chamber. Thus, the chamber seems qualified to be used as a primary standard. (DE)

26063 DETERMINATION OF G-VALUES IN FISSION RECOIL RADIOLYSIS. Freeman, J. P. Houston, TX; Univ. of Houston (1975). 42p. University Microfilms Order No. 76-778.

Thesis (Ph. D.).

N_2O was evaluated as a high-pressure gas-phase chemical dosimeter for fission recoil radiolysis. The precision for the measurement of total energy deposition by fission recoils in a high-pressure gas-phase substrate was determined to be +-12 percent over a density range of 12.5 to 127.5 g l^{-1} and a total absorbed energy range of 1.1×10^{20} to 9.0×10^{20} eV. Energy deposition efficiencies for individual fuel foils were calculated to range from 0.128 to 0.202 based on a total fission recoil energy of 162 MeV/fission. Employing the measured doses, G-values for the production of carbon monoxide from carbon dioxide by fission recoil radiolysis were evaluated as a function of carbon dioxide density in the range of 0.06 to 0.75 g cm^{-3}. Nitrous oxide, sulfur hexafluoride, propane and oxygen were used as additives for the evaluation of reaction mechanisms in the carbon dioxide radiolysis system. (Diss. Abstr. Int., B)

26064 SETUP FOR TESTING AND THE CERTIFICATION OF CHEMICAL DOSIMETERS OPERATING ON THE PRINCIPLE OF ABSORBED PHOTON RADIATION DOSE OF ^{60}Co AND ^{137}Cs. Berlyand, V. A.; Generalova, V. V.; Gurskii, M. N. Sov. At. Energy (Engl. Transl.); 38: No. 4, 319-321(Apr 1975).

Translated from At. Energ.; 38: No. 4, 253-254(Apr 1975).

A setup which can be used to calibrate certain chemical dosimeters with a substantially reduced error is described. The reference setup comprises the isotopic gamma sources MRKh-γ-100 and LMB-γ-1M; a calorimeter set with various absorbers resembling in their composition the most frequently used chemical dosimeters; and measuring and regulating instruments. (WHK)

26065 COMPARISON OF LiF AND $FeSO_4$ DOSIMETRY WITH CAVITY THEORY FOR HIGH-ENERGY ELECTRONS. Fregene, A. O. (Lagos Univ., Nigeria). Contract AT(11-27)-27. Radiat. Res.; 65: No. 1, 20-28(Jan 1976).

Using $FeSO_4$ dosimetry in a comparative study, the response of LiF dosimeter rods 1 mm in diameter by 6 mm in length to electron beams of initial energies in the range 5 to 39 MeV was investigated. The electron beam cavity theories of T. E. Burlin, R. J. Shelling, and B. Owen (1969), P. R. Almond and K. McCray (1970), and L. H. Bragg-Gray (1937) were employed in the estimation of absorbed doses. The LiF dosimeter was found energy independent over the range of electron energies covered. Bragg-Gray's and Almond's electron beam theories confirm this finding within 2 percent. The overall experimental error in the work is within 2 percent. Burlin's electron beam theory gave values that were considerably out, especially at the lower end of the range of energy covered. (auth)

Nuclear Spectroscopic Instrumentation

26066 (CEA-N-1817(Suppl.), pp 73-76) THREE-AXIS SPECTROMETER WITH POLARIZED NEUTRONS AND POLARIZATION ANALYSIS FOR INVESTIGATION OF MAGNETIC PROPERTIES. Schweizer, J.; Tasset, F. 1975.

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin No. 7, January-June 1975. ILL experiments. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

The instrument described may be used either as a conventional double-axis polarized neutron spectrometer or, with an analyzing crystal, as a three-axis spectrometer with polarization analysis. The instrument is fully automated, its specifications are given. (FR)

26067 (CEA-N-1817(Suppl.), pp 76-79) UTILIZATION OF AN IONIZATION CHAMBER FOR THE CHARGE ANALYSIS OF FISSION PRODUCTS. Sistemish, K.; Bocquet, J. P.; Chauvin, C.; Glaize, Y.; Armbruster, P. 1975. (In French)

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin No. 7, January–June 1975. ILL experiments. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

Fission products passing through the ionization chamber undergo an energy loss ΔE which is small compared to the initial energy E_0 (E_0 is of the order of 100 MeV in the light group). The fission product trajectory is situated in a plane parallel to the plates and particles pass through a thin window before entering into the useful volume of the detector. The energy straggling introduced by the gas was measured in view of improving the resolution. The experiment showed that an ionization chamber could be used for nuclear charge analysis of elements with $Z < 30$, in the energy range of 1 MeV per nucleon. (FR)

26068 (IAEA-169(Vol. 3), pp 3 v.; v. 3 p. 329-338) STANDARDS FOR CALIBRATION OF SEMICONDUCTOR DETECTORS. Lammer, M. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Energy scales and fundamental standards are defined for gamma ray energies. A consistent set of primary and secondary energy calibration lines is tabulated. A set of detector efficiency calibration standards is presented that is derived from level schemes of the standard nuclei. The survey is restricted to γ-rays up to about 3 MeV which is sufficient for fission product decay studies. (auth)

26069 COMMERCIALLY AVAILABLE COMPTON SUPPRESSION NaI–Ge(Li) UNIT FOR LOW-LEVEL γ ANALYSIS OF ENVIRONMENTAL SAMPLES. Caruthers, L. T.; Morgan, D. W. (North Carolina State Univ., Raleigh). Health Phys.; 29: No. 6, 872-874(Dec 1975).

A Compton suppressed γ spectrometer, which is being used in an environmental surveillance program, is described. The detector, Compton suppression unit, anticoincidence counting system, pulse height analyzer and data handling equipment are specified. The performance of the system is discussed. The system was acquired early in 1974 and at that time the cost of the entire system was approx $43,000. All of the sub-parts of the system are commercially available off-the-shelf pieces of equipment. (UK)

26070 ASSOCIATED PARTICLE NANO-SECOND TIME OF FLIGHT SPECTROMETER FOR 2.5 MeV NEUTRONS. Cox, A. J.; Holland, D. (Aston Univ., Birmingham, Eng.). Int. J. Appl. Radiat. Isot.; 26: No. 12, 776-780(1975).

An associated particle nanosecond time-of-flight spectrometer for 2.5 MeV neutrons produced in the D(d, n) ^{3}He reaction is described and results of its performance testing are presented. Using calculated emergent ^{3}He energies a particle discriminating system using electrostatic deflection plates has been designed to eliminate other competing particles from reaching the ^{3}He detector. The time-of-flight electronics are shown in block diagram form. It is shown that energy levels only 0.5 MeV apart can be studied on small accelerators using inelastic scattering with 2.5 MeV neutrons with flight paths of 2.5 m. This spectrometer should be invaluable for the study of reactor materials in neutron fluxes whose energies correspond closely to the fission energies. (UK)

26071 γ-RAY SPECTRA DETECTED WITH HgI_2 AT ROOM TEMPERATURE. Puschert, W.; Scholz, H. (Philips Gmbh, Forschungslaboratorium Aachen, 51 Aachen, Germany). Appl. Phys. Lett. 28: No. 6, 357-359 (15 Mar 1976).

Detectors for γ rays working at room temperature were made of HgI_2 grown from the vapor phase by the method of dynamic gradient reversal. These detectors show a resolution (FWHM) of 2.3–3.5 keV for ^{241}Am γ rays (59.5 keV) with negligible effects on polarization and spectral response for counting rates up to 5000/sec. For ^{137}Cs γ rays (662 keV), the resolution could be increased for the first time to about 50 keV, provided that the thickness of the detectors was not more than about 0.5 mm. With a quasihemispherical detector, having a better efficiency, it was also possible to obtain a ^{137}Cs spectrum with a pronounced photopeak. (auth)

26072 TRANSPORT SOLENOID SEMICONDUCTOR ELECTRON SPECTROMETERS FOR NUCLEAR SPECTROSCOPY. Ferenc, T. (Atomki, Debrecen, Hungary). ATOMKI (At. Kut. Intez.) Kozl.; 17: No. 3, 257-279(1975). (In Hungarian)

A review with 45 references is presented on semiconductor electron spectrometers. The topics discussed are the characteristics, development of modifications, and adaptation to other types of spectrometers. (JSR)

High Energy Physics Instrumentation

26073 (CRN-HE-75-10) A CDC 1700 ON-LINE SYSTEM FOR THE ANALYSIS, DATA LOGGING AND MONITORING OF BIG BUBBLE CHAMBER PICTURES. Guyonnet, J.-L. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1975. 138p. (In French). INIS.

This work presents the analysis system of large bubble chambers such as Gargamelle and BEBC realized in the heavy liquid bubble chamber group with scanning and measurement stations on-line with a CDC 1700 computer. This work deals with the general characteristics of these stations and of the computer and puts emphasis on the conception and functions of the analysis programs: scanning, measurement and data processing. The data acquisition system runs in a context of real time multiprogramming. (FR)

26074 (JINR-10-7611) OPTICAL CONSTANTS OF THE PROGRAM FOR GEOMETRICAL RECONSTRUCTION OF EVENTS ON EXPOSITIONS OF THE 100-CM HYDROGEN BUBBLE CHAMBER IN A π^--MESON BEAM AT 5 GeV/c. D'yachkov, E. I.; Klugov, I.; Kozubskij, Eh. V.; Lebedev, R. M.; Saitov, I. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 8p. (In Russian). INIS.

8 refs.; 3 tables.

Tables are given for values of the optical constants to be used in the geometrical reconstruction of events for a 100-centimeter, hydrogen, bubble chamber in the High-Energy Lab of OIYaI. (tr-auth)

26075 (JINR-13-8299) ELECTRON TUBES FOR TERMINAL CASCADES OF HIGH-VOLTAGE PULSE GENERATORS FOR POWER SUPPLIES OF FILMLESS SPARK CHAMBERS. Elishev, A. F.; Filippov, P. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 16p. (In Russian). INIS.

6 refs.; 8 figs.

Consideration is given to the possibility of using tube GI-17 as a commutating element in the final cascades of high-voltage pulses, and to construction improvements by adding supplementary radiators which assures natural (not forced) cooling. A presentation is given of the pulse characteristics $I_m = f(U_0)$ for a single GI-17 tube, for two tubes (in parallel), and of the comparative pulse characteristics for a hydrogen thyratron TGI1-130/10 at various values of the voltage on the control grid during pulsing (excess). Graphs are presented for the dependence $I_m = f(R_H)$ at U_0 = const for the final cascades on a single GI-17 tube, on a thyratron TGI1-130/10 and on two GI-17 tubes. (tr-auth)

26076 (JINR-R-1-8402) APPLICATION OF SUPERSTRONG MAGNETIC FIELDS TO PHOTOEMULSION INVESTIGATION AT HIGH ENERGY. Tolstov, K. D.; Shabratova, G. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 14p. (In Russian). INIS.

18 refs.; 6 tables.

A presentation is given for the outlook of using pulse magnetic fields with a strength of 10^6 Oe in order to investigate the interaction of high-energy particles with nuclei on using photoemulsions. (tr-auth)

26077 COMPUTER INTERFACING FOR HIGH-ENERGY PHYSICS EXPERIMENTS. Kristen, F. A. (Lawrence Berkeley Lab., CA). Annu. Rev. Nucl. Sci.; 25: 509-554(1975).

The intent of this article is to outline the factors that influence the choice or design of the data-handling components, and their organization into systems useful for a class of high-energy physics experiments. The class is the one sometimes described by that rather loose term, "on-line." It includes those experiments in which data are acquired electrically, and analyzed or recorded by electrical means. (auth)

Radiometric Instruments

26078 METHOD OF MONITORING COATINGS BY REFERENCE TO THE YIELD OF BREMS RADIATION (BREMSSTRAHLUNG). Borisov, V. P.; Zykov, V. M.; Kononov, B. A. (Scientific-Research Inst. of Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 2, 153-155(1975).

Translated from Defektoskopiya; 11: No. 2, 33-36(1975).

A method of monitoring the thickness of 1-3-g/cm^2 coatings on

layered objects by reference to the brems radiation arising from monoenergetic electrons incident on the side of the coating is examined. A comparison is drawn with methods of testing based on the absorption and back reflection of fast electrons.

26079 NUCLEAR-RESONANCE METHOD OF MEASURING THE DEPTH OF THIN LAYERS AND FILM COATINGS. Glazkova, Ya. P. (Mariisk Univ., USSR). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 2, 147-152(1975).

Translated from Defektoskopiya; 11: No. 2, 25-33(1975).

Nuclear-resonance methods of measuring the thickness of thin films based on selective absorption of neutrons and γ rays are discussed. The operation and basic characteristics of two thickness gauges are described.

26080 IONIZIRUYUSHCHIE IZLUCHENIYA V AVIATSIONNOI I KOSMICHESKOI TEKHNIKE. (Ionizing Radiations in Aviational and Space Technology). Zykov, I. K.; Varyushchenko, S. B. Moscow; Atomizdat (1975). 128p.

The general principles for the construction of measurement devices based on the use of ionizing radiation for the determination of different parameters in aviation and space technology are examined. The basic theoretical premises of the measurement methods, possibilities for their practical realization, and the results of experimental studies and practical applications are discussed. The applications discussed include the measurement of spacing, rates of movement, angles, atmospheric density, analysis of the composition of the planet and its atmosphere, thickness, and levels. (JSR)

26081 PLOTNOSTNOI GAMMA-GAMMA-KAROTAKH NA RUDNYKH MESTOROZHENIYAKH. (Metodicheskie Rekomenlatsin). (Density Gamma-Gamma Well Logging in Ore Deposits. (Methodical Recommendations)). Artsybashev, V. A.; Ivanyukovich, G. A. Moscow; Atomizdat (1975). 72p.

Practical recommendations are given in methodical and technical aspects of density γ-γ well logging on ore deposits by means of single clamped probes. The physical principles of the γ-γ method and the characteristics of specific devices are examined. The methods for calibrating the GGK-P in density units are described. Factors affecting the results obtained with this instrument and methods of interpreting the diagrams obtained are given. (tr-auth)

26082 COSMIC-RAY SNOW GAUGE. Kodama, M.; Kawasaki, S.; Wada, M. (Inst. of Physical and Chemical Research, Tokyo). Int. J. Appl. Radiat. Isot.; 26: No. 12, 774-775(1975).

The advantages of using cosmic ray neutrons as the radiation source for a snow gauge are enumerated. Using two differently modulated cosmic ray neutron detectors, count rates as a function of water depth have been obtained and are shown graphically. Results of a field experiment using a cosmic ray snow gauge on Mt. Norikura are presented. (UK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 25873.

26083 (AD/A-005590) NUCLEAR RADIATION TESTING OF DIODES, SILICON CONTROLLED RECTIFIERS, TRANSISTORS AND INTEGRATED CIRCUITS. Technical Report. Cassidy, E. T. (Picatinny Arsenal, Dover, N. J. (USA)). Dec 1974. 76p. (PA-TR-4692. NTIS $4.75.

Extensive nuclear radiation tests were conducted on various types of diodes, transistors, silicon controlled rectifiers, DTL and CMOS integrated circuits for use in digital electronics. The nuclear radiation effects considered during this test program were endoatmospheric, i.e., neutron and gamma dose rates. The digital electronics employing the semiconductors tested are used in either ground systems or low-flying missiles, therefore, no exoatmospheric effects such as x-rays were evaluated. The report documents the components tested, test methods, radiation test facilities used and the test results for each component tested. (GRA)

26084 (AD/A-005617) COMPONENT DAMAGE/MALFUNCTION LEVELS. Final Report. (Boeing Aerospace Co., Seattle, Wash. (USA)). Dec 1974. Contract DACA87-72-C-0002. 96p. (TM-15). NTIS $4.75.

Damage/malfunction thresholds for mission-critical EMP-sensitive equipment of the SAFEGUARD Tactical Support Equipment have been determined by analysis and by laboratory tests. For inductive components and equipments insulation breakdown is the damage mechanism. For equipment containing solid-state semiconductors burnout of the sensitive piecepart governs. For low-voltage capacitors overvoltage at the capacitor is the damage mechanism. Methods used to calculate the damage/malfunction thresholds are given and a summary of the laboratory test results is presented. (GRA)

26085 (AD/A-005618) RFI FILTER EVALUATION. Final Report. (Boeing Aerospace Co., Seattle, Wash. (USA)). Dec 1974. Contract DACA87-72-C-0002. 48p. (TM-80). NTIS $3.75.

EMP isolation provided by RFI filters in the SAFEGUARD North Dakota site is evaluated. A mathematical model of typical filters is developed. Comparisons with manufacturing acceptance specifications and with test measurements onsite are used to confirm the model. Isolation of EMP transients in the SAFEGUARD installation is shown to be at least 50 dB. (GRA)

26086 (AD/A-005621) EMPIRICALLY DERIVED TRANSFER FUNCTIONS THREAT ENVIRONMENT TO INTERNAL ENVIRONMENT (S-ZONE) RLOB. Final Report. (Boeing Aerospace Co., Seattle, Wash. (USA)). 4 Dec 1974. Contract DACA87-72-C-0002. 27p. (TM-84). NTIS $3.75.

Magnetic-field transfer functions for outside-to-inside test positions are presented. The transfer functions were determined from the RLOB Site Test 5 test data. In addition, comparison is made between transfer functions derived from test data and calculated transfer functions. (GRA)

26087 (AD/A-005622) SURGE SUPPRESSOR ISOLATION DEVICES. Technical Memo. (Boeing Aerospace Co., Seattle, Wash. (USA)). Dec 1974. Contract DACA87-72-C-0002. 44p. (TM-86). NTIS $3.75.

A theoretical and empirical analysis was conducted to determine the effectiveness of surge capacitors and surge arrestors in suppressing EMP-induced transients. The attenuation was found to be only 3 dB for a 10 nanosecond risetime pulse and 9 dB for a 100 nanosecond risetime pulse. For slower pulses the surge arrestors and capacitors operated normally. (GRA)

26088 (AD/A-005623) EMPIRICALLY DERIVED TRANSFER FUNCTIONS THREAT ENVIRONMENT TO INTERNAL ENVIRONMENT (S-ZONE) MSPP. Final Report. (Boeing Aerospace Co., Seattle, Wash. (USA)). 4 Dec 1974. Contract DACA87-72-C-0002. 28p. (TM-88). NTIS $3.75.

Magnetic-field transfer functions for outside-to-inside test positions are presented. The transfer functions were determined from the MSPP Site Test 7 test data. In addition, comparison is made between transfer functions derived from test data and calculated transfer functions. (GRA)

26089 (AD/A-005624) ALERT ATTACK SWITCH ISOLATION. Technical Memo. (Boeing Aerospace Co., Seattle, Wash. (USA)). Dec 1974. Contract DACA87-72-C-0002. 41p. (TM-89). NTIS $3.75.

The transients on the internal (to the facilities) portion of soft circuits due to their external EMP pickups can adversely affect the critical hardware performance either directly through introduction of perturbations to the power bus(es) they are connected to, or indirectly through cross-coupling to totally unrelated circuits which are in their physical proximity. The Alert Attack Switch (AAS) system disconnects external soft circuits, thereby providing protection to internal, critical subsystems from the EMP transients induced on external circuits. This memorandum presents a mathematical description relating the input (external) and output (internal) EMP transient, on a circuit across an activated (open) alert attack switch. From the results the internal transient can be computed adequately for any given external transient wave shapes. Results of calculations are also presented for external transients of the double exponential type with time constants of interest. (GRA)

26090 (AD/A-006642) NUCLEAR ELECTROMAGNETIC PULSE (NEMP) HARDENED CABLES. Semiannual Report, 1 Jul 1973-30 Jun 1974. Wells, W. C. (IIT Research Inst., Chicago, Ill. (USA)). Jan 1975. Contract DAAB07-73-C-0341. 69p. NTIS $4.25.

When a system is exposed to a Nuclear Electromagnetic Pulse (NEMP), the cables which are used to connect the components act as antennas and couple NEMP energy into the system. The purpose of the program is to develop shields for a 26-pair communications cable which will significantly reduce the NEMP pickup. Because of the technical approach employed, however, many results of more general interest are obtained. (GRA)

Miscellaneous Instruments

Refer also to abstracts 25731, 25853, 26965, 27167, 27176, 27562, 28035, 28056, and 28187.

26091 (AD/A-006980) STRESS GAGE SYSTEM FOR THE MEGABAR RANGE. Final Report, 2 Apr 1973–30 Jun 1974. De Carli, P. S. (Stanford Research Inst., Menlo Park, Calif. (USA)). Jun 1974. Contract DNA001-73-C-0225. 45p. NTIS $3.75.

The report covers a one-year study of the feasibility of measuring stress wave profiles in the megabar range. The primary objective was accomplished with the successful manganin gage recording of a 1.2 megabar stress wave profile, including release to zero stress. The conductivities of various insulators were measured at shock stresses of 700-800 kbar. Lucalox (Al_2O_3 ceramic), fused silica, and a Cabal glass were excellent insulators in this stress range. The electrical resistivity of epoxy at high shock stresses was improved by adding Al_2O_3 powder. The mutual inductance particle velocity gage did not show promise of working at very high stresses in a nuclear test environment. Further developmental work is suggested. (GRA)

26092 (EUR-CEA-FC-781) RESOLUTION OF A WIEN FILTER WITH A LARGE OPENING OF THE ENTRANCE SLIT. Theiss, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur al Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Aug 1975. 24p. (In French). INIS.

A simple formula is derived for the resolution of a Wien filter. The formula which takes into consideration the opening of the entrance slit and the brightness of the entering beam can be easily applied. The formula has been compared with the measured resolution of a Wien filter. (FR)

26093 (HEDL-TME-75-53) DESIGN AND PERFORMANCE OF A MICROWAVE STRAIN MEASURING SYSTEM FOR MATERIALS TESTS. Billeter, T. R.; Blackburn, L. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract AT(45-1)-2170. 27p. Dep. NTIS $3.50.

Excellent sensitivity and accuracy in the measurement of deformation occurring in materials tests have been achieved with a newly developed microwave frequency sensor and instrumentation system with possible application for strain tests inside nuclear reactors. The strain sensor comprises a microwave cavity resonating in the circular TE 113 and TM 110 modes. Detection of axial strain occurs due to the changes of resonant frequency incurred by cavity length changes. Axial strain sensitivity for the TE 113 mode was 6×10^{-6} per MHz, whereas radial dimensions of the cavity were related to frequency of the TM 110 mode. Aperture coupling of the cavity to the end wall of K/sub a/ band waveguide provided signal excitation of the two monitored modes. Phase locked frequency stability enabled digital count/display of resonant frequencies to within 70 kHz at 35 GHz. Room temperature tension test results demonstrate a strain measuring sensitivity (+- 1×10^{-6}) and accuracy (+-1 percent of the measured value) equivalent to those of electrical resistance strain gages. The system yields accurate measurements of elastic strains as well as small departures from elastic response and hysteresis behavior during unloading and reloading. Creep test results confirm that measurement sensitivity and accuracy are retained in elevated temperature tests. Strain response on loading, subsequent creep deformation and creep recovery after unloading can all be measured in detail. Stability of microwave sensor calibration after exposure for 22×10^6 seconds at temperatures from 728°K to 866°K is shown to be excellent.

26094 DESIGN TO MINIMIZE EXPOSURE TO SCATTERED X-RAY RADIATION. Shepard, R. L. (Celanese Fibers Co., Charlotte, NC). X-Ray Spectrom.; 4: No. 4, 202-204(Oct 1975).

A design is described which conforms to OSHA recommendations for good radiation protection procedures. This design can be used on most units where x-ray optics are exposed to the atmosphere. It proves sufficient and should make most non-vacuum x-ray units comply with today's recommended dosage levels. A survey of an x-ray fluorescence diffraction unit instrument gave results well below the maximum permissible level of 2.5 mr per hour for scattered radiation at a distance five centimeters from the housing surface. The detected scattered radiation was in the range of 0.03 mr per hour, which is within the limits of normal background radiation. (auth)

26095 ULTRASONIC TRANSDUCER. Karplus, H. H. B. (to U.S. Energy Research and Development Administration). US Patent Application 565,020. Filed date 3 Apr 1975. 7p.

An ultrasonic transducer capable of use in a high-temperature environment incorporates a laminated metal coupling wedge including a reflecting edge shaped as a double sloping roof and a transducer crystal backed by a laminated metal sound absorber disposed so as to direct sound waves through the coupling wedge and into a work piece, reflections from the interface between the coupling wedge and the work piece passing to the reflecting edge. Preferably the angle of inclination of the two halves of the reflecting edge are different. (auth)

26096 ADJUSTABLE EXTENDER FOR INSTRUMENT MODULE. Sevec, J. B.; Stein, A. D. (to U.S. Energy Research and Development Administration). US Patent 3,917,369. H01B07/06; H01R05/00. 4 Nov 1975. Filed date 26 Aug 1974. 4p.

PAT-APPL-500,708.

A blank extender module used to mount an instrument module in front of its console for repair or test purposes has been equipped with a rotatable mount and means for locking the mount at various angles of rotation for easy accessibility. The rotatable mount includes a horizontal conduit supported by bearings within the blank module. The conduit is spring-biased in a retracted position within the blank module and in this position a small gear mounted on the conduit periphery is locked by a fixed pawl. The conduit and instrument mount can be pulled into an extended position with the gear clearing the pawl to permit rotation and adjustment of the instrument.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

26097 (AAEC/E-365, pp vp, Chapter 6) SOURCES OF POLLUTION. Conway, N. F.; Davy, D. R.; Lowson, R. T.; Ritchie, A. I. M. Sep 1975.

In Rum Jungle environmental studies. (Australian Atomic Energy Commission Research Establishment, Lucas Heights).

Rainwater falling on overburden heaps provides three sources of Zn, Cu, and Mn pollution to the East Finniss River system. Estimates are made of the contribution of these three sources and these are summed to give the total burden presented to the river system. Estimates are also made of contribution of heavy metals from the seepage and overtopping of opencuts. (auth)

26098 (K-1839) BEHAVIOR OF THE MINOR URANIUM ISOTOPES IN SEPARATION CASCADES. Part V. Review and Appraisal. Blumkin, S.; Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 19 Jan 1976. Contract W-7405-eng-26. 33p. Dep. NTIS $5.00.

Part V is the final chapter of the completion report for this study. The results of the calculations made to determine the behavior of the minor uranium isotopes (U-234 and U-236) in separation cascades and the results of the two plant tests made to substantiate the validity of the calculations are reviewed briefly. Based on the fact that the U-234 and U-236 concentrations relative to that of U-235 in cascade withdrawal streams reflect the cascade flowsheet, it is concluded that the use of the minor isotope concentration measurements in cascade withdrawal streams, which is usually referred to by the acronym, MIST, is a potentially valuable adjunct to material accounting for safeguarding a U-235 enrichment cascade. A characteristic of MIST which qualifies it particularly for safeguards application under the NPT is the fact that its use is entirely non-intrusive with regard to process technology and proprietary information. The usefulness of MIST and how it may be applied are discussed briefly. To conclude this appraisal of MIST an enumeration is made of the capabilities that a safeguards inspection team would have to possess in order to apply MIST. (auth)

26099 SEPARATION OF ISOTOPES BY CYCLICAL PROCESSES. Hamrin, C. E.; Weaver, K. (to U.S. Energy Research and Development Administration). US Patent Application 557,566. Filed date 11 Mar 1975. 13p.

Various isotopes of hydrogen are separated by a cyclic sorption process in which a gas stream containing the isotopes is periodically passed through a high pressure column containing a palladium sorbent. A portion of the product from the high pressure column is passed through a second column at lower pressure to act as a purge. Before the sorbent in the high pressure column becomes saturated, the sequence is reversed with the stream flowing through the former low-pressure column now at high pressure, and a portion of the product purging the former high pressure column now at low pressure. The sequence is continued in cyclic manner with the product being enriched in a particular isotope. (auth)

26100 LASER ISOTOPE SEPARATION BY MULTIPLE PHOTON ABSORPTION. Robinson, C. P.; Rockwood, S. D.; Jensen, R. J.; Lyman, J. L.; Aldridge, J. P. III. (to U.S. Energy Research and Development Administration). US Patent Application 570,924. Filed date 22 Apr 1975. 15p.

Multiple photon absorption from an intense beam of infrared laser light may be used to induce selective chemical reactions in molecular species which result in isotope separation or enrichment. The molecular species must have a sufficient density of vibrational states in its vibrational manifold that, in the presence of sufficiently intense infrared laser light tuned to selectively excite only those molecules containing a particular isotope, multiple photon absorption can occur. By this technique, for example, intense CO_2 laser light may be used to highly enrich ^{34}S in natural SF_6 and ^{11}B in natural BCl_3. (auth)

26101 METHOD OF ISOTOPE SEPARATION BY CHEMI-IONIZATION. Wexler, S.; Young, C. E. (to U.S. Energy Research and Development Administration). US Patent Application 580,499. Filed date 23 May 1975. 17p.

A method is given for separating specific isotopes present in an isotopic mixture by aerodynamically accelerating a gaseous compound to form a jet of molecules, and passing the jet through a stream of electron donor atoms whereby an electron transfer takes place, thus forming negative ions of the molecules. The molecular ions are then passed through a radiofrequency quadrupole mass filter to separate the specific isotopes. This method may be used for any compounds having a sufficiently high electron affinity to permit negative ion formation, and is especially useful for the separation of plutonium and uranium isotopes. (auth)

26102 ENRICHMENT: NEW PROCESSES BUT HIGHER PRICES. Nucl. Eng. Int.; 20: No. 231, 576-579(Jun 1975).

New processes for uranium enrichment which were described and discussed at the BNES-KtG Conference on Uranium Isotope Separation, in London, March 1975 are reviewed. These include a wide variety of processes based on plasma excitation, vapour or atomic beam deflection and centrifugal effects in plasma rotating at very high speed. The basic principles underlying these concepts and their possibilities are discussed. It is concluded that while some of the concepts may promise exciting long term prospects, real progress is expected to take decades. (UK)

26103 ^{18}O ENRICHMENT PROCESS IN UO_2F_2 UTILIZING LASER LIGHT. DePoorter, G. L.; Rofer-DePoorter, C. K. (to U.S. Energy Research and Development Administration). US Patent 3,923,619. B01J1/10. 2 Dec 1975. Filed date 16 Sep 1974. 4p.

PAT-APPL-506,479.

Photochemical reaction induced by laser light is employed to separate oxygen isotopes. A solution containing UO_2F_2, HF, H_2O and a large excess of CH_3OH is irradiated with laser light of appropriate wavelength to differentially excite the UO_2^{2+} ions containing ^{18}O atoms and cause a reaction to proceed in accordance with the reaction $2\ UO_2F_2 + CH_3OH + 4\ HF$ yields $2\ UF_4$ down arrow $+ HCOOH + 3\ H_2O$. Irradiation is discontinued when about 10 percent of the UO_2F_2 has reacted, the UF_4 is filtered from the reaction mixture and the residual CH_3OH and HF plus the product HCOOH and H_2O are distilled away from the UO_2F_2 which is thereby enriched in the ^{18}O isotope, or the solution containing the UO_2F_2 may be photochemically processed again to provide further enrichment in the ^{18}O isotope.

26104 STAGE DESIGN. Shacter, J. (to U. S. Energy Research and Development Administration). US Patent 3,925,036. B01D13/00. 9 Dec 1975. Filed date 23 Mar 1951. 6p.

PAT-APPL-217,116.

A method is described of cycling gases through a plurality of diffusion stages comprising the steps of admitting the diffused gases from a first diffusion stage into an axial compressor, simultaneously admitting the undiffused gases from a second diffusion stage into an intermediate pressure zone of said compressor corresponding in pressure to the pressure of said undiffused gases, and then admitting the resulting compressed mixture of diffused and undiffused gases into a third diffusion stage.

26105 METHOD OF RECOVERING URANIUM HEXAFLUORIDE. Schuman, S. (to U. S. Energy Research and Development Administration). US Patent 3,925,536. C01G43/06. 9 Dec 1975. Filed date 19 Jun 1947. 6p.

PAT-APPL-755,755.

A method of recovering uranium hexafluoride from gaseous mixtures which comprises adsorbing said uranium hexafluoride on activated carbon is described.

26106 THE ENRICHMENT SITUATION IN THE GERMAN FEDERAL REPUBLIC. Roth, B. F. (Badenwerk A. G., Karlsruhe (F. R. Germany). Abt. Kernkraftwerke). At. Strom; 21: No. 9/10, 90-92(Sep 1975). (In German)

3 figs. Revised paper presented at the international conference on uranium isotope separation, London (UK), 5 Mar 1975.

Separation energy requirement and the supply situation in the German Federal Republic are reviewed. The requirement is based on the present forecast of the planned installed electrical output from nuclear energy in accordance with the energy program of the federal government. The enrichment requirement in the EEC is also discussed taking into account the various uncertainties in the long-term forecast. The most important conditions in an enrichment contract and the development of prices are dealt with. Finally the future enrichment policy in the German Federal Republic is discussed from the point of view of the electricity supply companies. (DE)

26107 URANIUM ENRICHMENT. Projects and Plans. Braatz, U. (Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (F. R. Germany)). At. Strom; 21: No. 9/10, 88-90(Sep 1975). (In German)

2 tabs.

Up to a short time ago there was uncertainty about adequate enrichment capacities at the beginning of the 80's. The projects commenced in the western world should however ensure the necessary reliability of supply for the growing nuclear energy programs. The main problem in uranium enrichment is no longer the technology, but obtaining the considerable investment funds for the construction of the new installations. (DE)

26108 AN INSTALLATION FOR SEPARATING GASES THROUGH DIFFUSION. Lalis, A. (Societe de Construction d'une Usine de Separation Isotopique (USSI), 92—Le Plessis-Robinson (France)); Rouvierez, R. (Societe de Fabrication d'Elements Catalytiques (SFEC), 84—Bollene (France)); Simon, G. (CEA, 75—Paris (France)). (to CEA, 75—Paris (France)). French Patent 2,229,448/A/. 18 May 1973. 14p. (In French)

Description is given of a multi-passage diffuser using porous tubes as a barrier. The diffuser comprises a sealed enclosure wherein are mounted parallel porous tubes divided into groups by means of clamps. The tubes at the upper end thereof, are integral with a manifold in the shape of a semi-torus defined by its median plane, (said manifold not being connected to the enclosure), and at the lower end thereof, with the enclosure bottom. This can be applied to enriching a gaseous isotopic mixture with light isotopes. (FR)

Isotopic Power Sources

Refer also to abstracts 26409 and 26707.

26109 (AD/A-008191) OPERATING REPORT FOR RADIOISOTOPIC POWER GENERATORS OF THE U. S. NAVY. Volume 8, Number 1. Report for 1 Jan-30 Sep 1974. (Naval Nuclear Power Unit, Fort Belvoir, Va. (USA)). 30 Sep 1974. 79p. NTIS $4.75.

See also report dated 31 Dec 1973, AD-781261.

The objective of this operating report is to serve as a vehicle for the accumulation and dissemination of information concerning the application and operation of radioisotopic power generators (RPGs) within the Navy. It will be noted that all RPGs presently listed are radioisotope thermoelectric generators (RTGs). Unless specifically identified as an engineering evaluation, items contained in this report are presented as an impartial collection of facts, observations and other information. (GRA)

26110 (PB-239086) DEVELOPMENT AND EVALUATION OF A STIRLING CYCLE ENERGY CONVERSION SYSTEM. Annual Report, May 1973-July 1974. Andrus, S.; Faeser, R. J.; Moise, J.; Hoffman, L. C.; Rudnicki, M. I. (Aerojet Liquid Rocket Co., Sacramento, Calif. (USA)). Aug 1974. Contract PHS-73-2930. 113p. NTIS $5.25.

See also PB-226617.

The Stirling cycle engine is designed to power implantable heart-assist and total-heart-replacement systems. Heat is provided by a ^{238}Pu radioisotope capsule. Program activity during the report period included development and in vivo testing of the Heart Assist System including the PAC-4 actuator and the MK V engine; design of an advanced actuator, PAC-5; and design, fabrication and testing of the THA-1 Total Heart actuator. (GRA)

26111 (PB-239447) VAPOR CYCLE ENERGY SYSTEM FOR IMPLANTABLE CIRCULATORY ASSIST DEVICES. Annual Report, Jul 1973—Jul 1974. Hagen, K. G. (Thermo Electron Corp., Waltham, Mass. (USA)). Aug 1974. Contract N01-HV-4-2909. 160p. (TE-4182-29-75). NTIS $6.25.

See also PB-237621.

The report describes the development status of a heart assist system driven by a nuclear fueled, electronically controlled vapor cycle engine termed the tidal regenerator engine (TRE). The TRE pressurization (typically from 5-160 psia) is controlled by a torque motor coupled to a displacer. The electrical power for the sensor, electronic logic and actuator is provided by a thermoelectric module interposed between the engine superheater and boiler. The TRE is direct coupled to an assist blood pump which also acts as a blood-cooled heat exchanger, pressure-volume transformer and sensor for the electronic logic. Engine efficiencies in excess of 10 percent have been demonstrated. A binary version of the engine with twice the potential efficiency is being investigated. Efficiency values as high as 13 percent have been achieved to date. (GRA)

Radiation Sources

26112 (BNWL-1967) CONTAINMENT OF $^{90}SrF_2$ AT 800 TO 1100°C PRELIMINARY RESULTS. Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. vp. Dep. NTIS $7.75.

A program is currently underway at PNL to develop the data needed to license $^{90}SrF_2$ for heat source applications. A major portion of the program involves determining the compatibility of $^{90}SrF_2$ with containment materials at elevated temperatures. The compatibility studies are divided into two phases: an initial series of short-term scouting tests lasting up to 4400 h in which a number of containment materials were evaluated, and a subsequent series of long-term tests in which the three best containment materials identified in the short-term tests will be tested for up to 30,000 h with WESF-produced $^{90}SrF_2$. The results of the first phase tests are summarized. The short-term tests were carried-out at temperatures of 800, 1000, and 1100°C for 1500 and 4400 h using both radioactive and nonradioactive strontium fluoride. Nine potential containment materials were evaluated in the tests: two refractory metals (tungsten and TZM); two cobalt base alloys (Haynes Alloy 25 and Haynes Alloy 188); and five nickel base alloys (Hastelloy C-276, Hastelloy X, Hastelloy N, Inconel 600 and Inconel 625). Test results show that both of the refractory metals are very resistant to fluoride attack, and tungsten and TZM specimens exposed to $^{90}SrF_2$ exhibited little or no attack. Haynes Alloy 25 was the best of the Ni- and Co-base alloys, but attack up to a depth of 0.004 in. was observed in some Haynes Alloy 25 specimens exposed to $^{90}SrF_2$. Based on the results of the short-term compatibility tests and several other factors, TZM, Haynes Alloy 25 and Hastelloy C-276, the present WESF capsule material, were selected for long-term testing with $^{90}SrF_2$. (auth)

26113 (GSF-K-75, pp v) FUNDAMENTALS OF THE DOSIMETRY OF ENERGY-RICH RADIATION. Pohlit, W. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

A history of the development of dosimetry using ionizing radiation is given, and the physical parameters of the radiation sources, the radiation fields, interactions with matter, and measuring principles are considered. (DE)

26114 (SAND-76-0065) BENEFICIAL USES PROGRAM. Progress Report, Period Ending 31 December 1975. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 80p. Dep. NTIS $5.00.

Progress is reported on studies designed to develop the necessary technologies for cost-beneficial uses of existing and future surplus radioactive materials. The purpose of the Waste Resources Utilization Program is to develop a technology to utilize cesium-137, a nuclear power plant by-product, to modify sewage sludge for safe application as a fertilizer or as an animal feed supplement. A major portion of the effort this quarter was directed toward establishment of thermoradiation treatment levels for elimination of pathogenic organisms in sludge. Three groups of pathogenic microorganisms are being studied: viruses, bacteria, and parasites. Other areas of study included physical-chemical properties of thermoradiation treated sewage sludge such as "settling" and "filterability" and pilot plant design for a plant to thermoradiate up to 75 kiloliters of sludge per day. In the Separation Technology and Source Development Program previous work has demonstrated the feasibility of applying the Sandia Solidification Process to the recovery of radiocesium from high-level liquid wastes. The influence of various parameters on ^{137}Cs source intensities was explored. A multiple ceramic ^{137}Cs source package was found to be essentially the same from a radiation process viewpoint as a single ^{137}Cs source. The tolerable impurity levels in the ceramic sources, in terms of perturbation of the gamma flux, are relatively high (a few percent). (JGB)

Design and Fabrication

26115 (CEA-CONF-3117) A STANDARD 9 MeV γ BEAM FOR DETECTOR CALIBRATION. Troesch-Lasseur, G.; Bermann, F.; Gaulard, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service de Protection contre les Rayonnements). 1975. 7p. (In French). .INIS.

From 3rd European congress of the International Radiation Protection Association. Criteria for radiation protection; Amsterdam, Netherlands (13 May 1975).

A γ capture irradiation device with beam extraction is being developed at Triton. The mean energy in the beam is 9 MeV. The beam intensity has been determined from absorbed dose measurements according to ICRU specifications. The maximum dose rate taken as calibration standard is 125 ± 9rad/h. (FR)

26116 TISSUE IRRADIATOR. Hungate, F. P.; Riemath, W. F.; Bunnell, L. R. (to U.S. Energy Research and Development

Administration). US Patent 3,927,325. A61N5/12; G01N21/24; G21G4/00. 16 Dec 1975. Filed date 10 Jul 1974. 8p.

PAT-APPL-487,327.

A tissue irradiator is provided for the in-vivo irradiation of body tissue. The irradiator comprises a radiation source material contained and completely encapsulated within vitreous carbon. An embodiment for use as an in-vivo blood irradiator comprises a cylindrical body having an axial bore therethrough. A radioisotope is contained within a first portion of vitreous carbon cylindrically surrounding the axial bore, and a containment portion of vitreous carbon surrounds the radioisotope containing portion, the two portions of vitreous carbon being integrally formed as a single unit. Connecting means are provided at each end of the cylindrical body to permit connections to blood-carrying vessels and to provide for passage of blood through the bore. In a preferred embodiment, the radioisotope is thulium-170 which is present in the irradiator in the form of thulium oxide. A method of producing the preferred blood irradiator is also provided, whereby non-radioactive thulium-169 is dispersed within a polyfurfuryl alcohol resin which is carbonized and fired to form the integral vitreous carbon body and the device is activated by neutron bombardment of the thulium-169 to produce tbe beta-emitting thulium-170.

26117 NEUTRON SOURCE. Cason, J. L. Jr.; Shaw, C. B. (to U.S. Energy Research and Development Administration). US Patent 3,914,612. G21G4/02. 21 Oct 1975. Filed date 26 Aug 1974. 6p.

PAT-APPL-500,790.

A neutron source which is particularly useful for neutron radiography consists of a vessel containing a moderating media of relatively low moderating ratio, a flux trap including a moderating media of relatively high moderating ratio at the center of the vessel, a shell of depleted uranium dioxide surrounding the moderating media of relatively high moderating ratio, a plurality of guide tubes each containing a movable source of neutrons surrounding the flux trap, a neutron shield surrounding one part of each guide tube, and at least one collimator extending from the flux trap to the exterior of the neutron source. The shell of depleted uranium dioxide has a window provided with depleted uranium dioxide shutters for each collimator. Reflectors are provided above and below the flux trap and on the guide tubes away from the flux trap.

26118 A VERSATILE FLASH RADIATION SYSTEM. Mattsson, A. pp 367-371 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps.). Paris, France; Association Nationale de la Recherche Technique ([nd]).

From 10th international congress of ultra-high-speed photography; Nice, France (25 Sep 1972).

Design and performance of a high voltage pulse generator and vacuum diode system are discussed. The pulse generator delivers 250 to 600 kV, 10 kA, 20 ns pulses with positive or negative polarity. It is used to pulse a continuously pumped vacuum-diode having an exchangeable electrode assembly. Short and intense bursts of x-rays, electrons and light can be obtained by simply changing the type of electrodes and the polarity of the high voltage pulse. The diode can be used, with a reflection anode, as a fine-focus flash x-ray tube having a source size of the order of 1 mm. Using a transmission anode a broad and intense x-ray beam can be generated suitable for radiation effect studies. High intensity electron pulses can be extracted through a thin metal anode for external use. The electron pulses can be converted into short, superradiant-light pulses using a semiconductor target. The emitted light is nearly monochromatic and different wavelengths are obtained for different target materials. In several applications a combination of more than one type of radiation may be used to increase the information.

26119 PRODUCTION OF ^{60}Co CERAMIC FUEL FORMS. Rankin, D. T.; Smith, P. K.; McBeath, P. E.; Keski, J. R.; McDonell, W. R. (E. I. du Pont de Nemours and Co., Aiken, SC). Contract AT(07-2)-1. Am. Ceram. Soc. Bull.; 54: No. 11, 982-985(Nov 1975).

From joint fall meeting of the Basic Science and Nuclear Divisions of the American Ceramic Society; Williamsburg, VA (27 Mar 1975).

The feasibility of producing ^{60}Co ceramic fuel forms of CoO, $Co_{0.5}Mg_{0.5}O$ and $CoAl_2O_4$ was demonstrated. Wafers of each oxide were fabricated to approximately 90 percent of theoretical density by powder ceramic processes. A total of 360 wafers was canned in aluminum and irradiated in control rod positions in a high flux charge to yield activities up to 700 Ci/g Co. Power densities calculated for CoO, $Co_{0.5}Mg_{0.5}O$ and $CoAl_2O_4$ from the average activity of 525 Ci/g were 37, 19, and 11 W(th)/cm^3, respectively. Postirradiation inspection showed wafers of each oxide to be intact with no significant change in volume or microstructure. Wafers of ^{60}Co fuel forms could be directly encapsulated into a heat source without reprocessing.

Industrial Uses

26120 (IEA-384) COUNTING WAVE SUBJECTED TO FIRST-ORDER DELAY (ANALOG SIMULATION). Viglioglia, M. A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Feb 1975. 20p. (In Portuguese). Dep. NTIS (US Sales Only) $3.50.

The use of an analog computer for the simulation of an actual physical system in order to predict the behavior of the system is illustrated. The example chosen for simulation is that of a scraper moving in an underground tunnel with a radiation source inside it and with a series of fixed detectors on the surface. The analog simulation is used to determine what time constant is necessary to detect a specific source and what minimum intensity is necessary for a source for its detection at a given time constant. The method developed uses the parametric technique which eliminates dividing units and thus gives improved precision of the results. (JSR)

26121 DETERMINATION OF CORROSION RATES IN LIQUID MEDIA USING RADIONUCLIDES. Vehlow, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Lab. fuer Isotopentechnik). Werkst. Korros.; 26: No. 5, 338-342(May 1975). (In German)

5 figs.; 3 tabs.; 14 refs.

The method described is simple and yields results in a short time even at rather low corrosion rates. The lowest rates measured were of the order of 1 to 10 mg/m^2/day. This sensitivity can be increased by suitable measuring setups. In the case of steels it is possible to separately measure up to three constituents, so that it is possible to study corrosion phenomena in the passivity and transition regions. γ- and β-radiation can be used but the former is preferable in particular for the analysis of several constituents. The half life of the radionuclides should be of the order of several hours and the γ-energies must not be below 100 keV. Experiments have been carried out with the following systems: CrNiMo-steels in sulfuric and hydrochloric acids and $FeCl_3$ solutions. (DE)

26122 WEAR MEASUREMENTS AT RAILWAY WHEEL TREADS AND BRAKE DISCS WITH THE RADIOMETRIC THIN-LAYER DIFFERENCE METHOD. Cabos, H. P.; Schmidt, W. (Bundesbahn-Versuchsanstalt, Minden (F. R. Germany)). Materialpruefung; 17: No. 6, 167-169(Jun 1975). (In German). (AED-CONF-75-096-001).

From meeting of the Deutscher Verband fuer Materialpruefung; Wuerzburg, F. R. Germany (3 Apr 1975). 4 figs.; 2 refs.

The investigation of important wear processes in railways, especially the differentiation of the parameters influencing the wear process, requires extensive test programs and high resolving methods to determine the wear. Radiometric methods enable considerably greater measuring accuracy, with the help of the activation of materials. (DE)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 25451, 25493, and 26138.

26123 (AED-CONF-75-388-003) THE ROLE OF TRYPTOPHAN IN THE PHOTOCHEMICAL CROSSLINKING OF PEPTIDES AND PROTEINS. Holt, L. A.; Milligan, B.; Rivett, D. E. 1975. 10p. INIS.

From 5th international symposium on wool textile research; Aachen, F. R. Germany (2 Sep 1975).

With abstract.

Irradiation of wool and several other proteins in the presence of ^{14}C-labelled tryptophan results in the covalent binding of radioactive material to the protein. This result is consistent with the claim that irradiation of proteins introduces crosslinks involving tryptophan residues. Radiolabelling techniques have been used to study the products of irradiation of the tripeptide, Ala-^{14}C-Trp-Val. Some of these products are polymeric–further evidence for the involvement of tryptophan in crosslinking reactions. Most of the yellow material produced during irradiation in air is polymeric. (DE)

26124 (COO-2448-2) CHARACTERIZATION OF IONIZING RADIATION DAMAGE IN DNA. Progress Report, May 1, 1975–April 30, 1976. Hawkins, R. B. (Saint Louis Univ., Mo. (USA). School of Medicine). 1976. Contract E(11-1)-2448. 30p. Dep. NTIS $4.00.

The objective of this research is the characterization and quantitative assay of ionizing radiation-induced damage in DNA and nucleoprotein. Two lines of investigation have been pursued. The first is aimed at detection and assay of DNA to protein covalent cross linkage in coliphage T7. Protein and DNA are labeled with ^{14}C and ^{32}P, respectively. Cross linkage is assessed from the amount of labeled protein distributing like DNA and labeled DNA distributing like protein on a phenol-water countercurrent distribution system. It has been found that damage involving cross linkage occurs by two modes of radiation action in phage irradiated with ^{60}Co gamma rays in .001M histidine medium. Indirect effects play a large role in one mode and direct effects play a large role in the other. In the second line of investigation, the hydrodynamic and viscoelastic properties of DNA from irradiated phage and cells will be examined to determine the extent to which DNA to DNA cross linkage and points of altered flexibility are introduced by radiation. An instrument for viscoelastic measurements has been constructed in preparation for these studies. (auth)

26125 (INIS-mf-1800) COMPARATIVE STUDIES ON THE EFFECTS OF GAMMA RAYS AND PROTONS 645 MeV ON THE TRANSFORMING ABILITY OF DNA IN CONDITIONS OF CHEMICAL RADIOPROTECTION. Minkova, M. I. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). 1974. 26p. (In Bulgarian). INIS.

Copies also available from Research Institute of Radiology and Radiation Hygiene, Sofia, Bulgaria.

The changes in the DNA transforming ability after treatment with different kinds of ionizing radiations and the possibility for radioprotection with sulfur containing compounds are studied. The Bacillus subtilis' transforming system, namely the marker tryptophan independence, was used for reading of the biological effect as a main test. DNA irradiation in solution (in vitro) or in protein containing cell medium (in vivo) with increasing doses gamma rays and protons (mean energy 645 MeV) leads to decrease of the transforming activity, which can be well defined by an exponential function. The analytical expression of the dose-response relationships shows that the inactivation of the DNA transforming properties from low LET radiations is realized by the one-hit mechanism. The absolute value for the yield of DNA inactivation, calculated from the mean lethal dose (D_{37}) show that radio-chemical changes in the nitrogen bases and the glucoso-phosphate residuals of the molecule are in the ground of the DNA functional injuries. The kinetics of lethal injuries accumulation is one genetical length of the DNA molecule, calculated from the residual transforming activity, is characterized by a quadratic dose dependence, which identifies the lethal injuries as two strands breakages in the DNA molecule. The comparative evaluation of the radiation effects after DNA irradiation in vitro and in vivo shows that the transforming activity of the isolated DNA is twice more radiosensible for both kinds of radiation. Comparison of the effects from gamma and proton irradiation practically does not show any quantitative or qualitative differences. The coefficients for RBE, calculated from the relation between the D_{37} are 0.91 and 0.82 for the irradiated in vitro, respectively for the irradiated in vivo system. The possibility for radioprotection of the DNA functional activity with cysteamine hydrochloride and cysteamine adenosine triphisphate (CYTRIPHOS^R) is demonstrated. In a toxic concentration both compounds have a high radioprotective activity after irradiation with gamma rays or protons 645 MeV in the dose range 10 to 150 Krads. CYTRIPHOS^R is nearly two times more effective than cysteamine, reading from the dose reduction factors. The transforming system of Bacillus subtilis is proposed as an appropriate and quick model for obtaining preliminary information when assessing RBE for different kinds of radiation and for screening of potential radioprotectors. (INIS)

26126 MODIFICATION OF THE CHARACTERISTICS OF CONFORMATIONAL TRANSITIONS IN X-IRRADIATED DNA BY METAL IONS. Kompaniets, M. I.; Zhidkov, V. A. (Inst. of Plant Physiology, Kiev). Stud. Biophys.; 52: No. 2, 81-92 (1975). (In German)

Effect of Mn^{2+}, Zn^{2+}, MoO_4^{2-} ions on thermal- and acid-induced transitions in irradiated DNA was studied. Mathematical simulation of conformational transitions was based on the computer analysis of absorption data. Adenine-thymine and guanine-cytosine base pairs fractions despiralized in conformational transition range were calculated at several temperature and pH points. Acid-induced transition analysis including consideration of spectral changes due to protonation of nitrogen bases, the protonation course of adenine, guanine and cytosine was obtained. The specificity of conformational transition changes in irradiated DNA-metal complexes connected with interaction between metal ions and different groups of DNA macromolecule is discussed. (auth)

26127 CROSS-SECTIONS FOR THE INACTIVATION OF RIBONUCLEASE BY SLOW HEAVY IONS. Watt, D. E.; Sutcliffe, J. F. (Dundee Univ., Eng.). Phys. Med. Biol.; 20: No. 6, 926-943(Nov 1975).

Average cross sections for inactivation of dry ribonuclease by H, He and N projectiles with energies between 100 eV and 10 keV are presented. The trend of the damage cross sections with particle energy was consistent with the trend of the molecular quasi-elastic scattering and ionization cross sections. A tentative radiation damage model is proposed in which single hit damage attributed to direct physical interactions by the primary and secondary radiations is supplemented by chemical action of the elastically scattered knock-on atoms which inactivate additional targets with an efficiency of 50 to 100%. Further experiments at energies below 100 eV are required for positive confirmation of the chemical efficiency. Free electrons (sub-ionizing) were chemically relatively innocuous (< 10% efficiency). Saturation effects were satisfactorily accounted for in this model. Inactivation penetration depths measured in the microcrystalline enzyme agreed with the theoretical predictions if a residual diffusion range of about 8 $\mu g\ cm^{-2}$ was included. The mean energy expenditure to produce inactivation of a ribonuclease molecule was found to vary from 30 eV for 100 eV protons to 220 eV for 10 keV He and N ions. (auth)

26128 TRACK STRUCTURE AND RADIATION EFFECT. Dystsov, V. N. pp 68-72 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124–.

Attempts to correlate the track structure of ionizing radiation and the resulting radiation effect are reviewed. An expression, based on contemporary experimental studies, is derived and compared with experimental data. The disagreement between theory and experiment are discussed and applied to breaks observed in the DNA molecule. (JSR)

26129 INFLUENCE OF IRRADIATION ON THE 3′, 5′-CYCLO-AMP PHOSPHODIESTERASE ACTIVITY IN ISOLATED RAT THYMOCYTES. Zhivotova, N. I.; Filippovich, I. V. Romantsev, E. F. (Inst. of Biophysics, Moscow). Dokl. Biochem.; 222: No. 1-6, 215-218(1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 3, 736-739 (May 1975).

The effects of γ radiation on the activity of 3′,5′-cycloAMP phosphodiestorase in rat thymocytes at early periods following irradiation of the animals (rats) or of isolated thymocytes was studied. It was found that the activity of the enzyme was decreased following irradiation of the animal, whereas the activity was unchanged following irradiation of the isolated thymocytes. (ERB)

26130 PHOTOLYSIS OF 5-BROMOURACIL AND SOME RELATED COMPOUNDS IN SOLUTION. Pt. 6. Campbell, J. M.;

von Sonntag, C.; Schulte-Frohlinde, D. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr (F. R. Germany). Abt. fuer Strahlenchemie). Z. Naturforsch., b; 29: 750-757 (1974).

7 figs.; 5 tabs.; 24 refs.

The steady state photolysis of 5-bromouracil (BU) in aqueous solution was studied as a function of wavelength, pH, temperature, and hydrogen-donor concentration. Under all conditions studied, the primary reaction is shown to be C-Br bond cleavage followed by abstraction from the hydrogen-donor to give uracil and HBr. At pH > 12 further products are formed. In deoxygenated aqueous solution at pH 6, 20°C, and 254 nm, the quantum yield of BU consumption, Φ (-BU), is 1.8×10^{-3} independent of hydrogen-donor type or concentration (e.g. 3×10^{-2} to 2 m MeOH). With increasing pH, Φ (-BU) increases stepwise to 0.012 at pH 10 and to 0.28 at pH 14. pK-values calculated from these data are the same as ground state pK values. The results were explained in terms of a homolytic dissociation of the C-Br bond of the excited BU followed by recombination of H atom abstraction by the radicals. At high hydrogen-donor concentration H atom abstraction can compete with cage recombination. A comparison was made between BU photolysis in organic, hydrogen-donor solvents and BU photolysis within the DNA of bacteria or phages. (DE)

26131 RADIATION CHEMISTRY OF DNA-MODEL COMPOUNDS. Pt. 7. On the Formation of 5-Deoxy-D-Erythro-Pentos-4-Ulose and the Identification of Twelve Further Products from γ-Irradiated Aqueous Solutions of Ribose-5-Phosphate. Stelter, L.; von Sonntag, C.; Schulte-Frohlinde, D. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr (F. R. Germany). Abt. fuer Strahlenchemie). Z. Naturforsch., b; 30: No. 4, 656-657(Jul 1975).

9 refs.

Different mechanisms are considered to explain the formation of 5-deoxy-D-erythro-pentos-4-ulose in the γ-radiolysis of ribose-5-phosphate in aqueous solution. On the basis of deuterium labelling experiments one mechanism involving an enol as an intermediate could be excluded. The identification of twelve further radiolysis products from ribose-5-phosphate is reported. (DE)

26132 RADIATION CHEMISTRY OF DNA-MODEL COMPOUNDS. Pt. 8. Dephosphorylation Products from Reactions of OH Radicals with Ribose-5-Phosphate in Aqueous Solution. The Effect of Oxygen. Stelter, L.; von Sonntag, C.; Schulte-Frohlinde, D. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr (F. R. Germany). Abt. fuer Strahlenchemie). Z. Naturforsch., b; 30: No. 4, 609-615(Jul 1975).

3 figs.; 1 tab.; 21 refs.

The reaction of hydroxyl radicals with ribose-5-phosphate in oxygenated aqueous solution leads to the following phosphate free products (G-values): erythrodialdose (0.4), formic acid (0.4) and ribodialdose (0.1). In addition, inorganic phosphate (0.6) and some minor phosphate free products (total G approximately 0.08) are formed. Within the limits of experimental error material balance between dephosphorylation products and inorganic phosphate is obtained. A mechanism is proposed which can account for the main products. The primary steps of the dephosphorylation are H atom abstraction from C-5 of ribose-5-phosphate by OH radicals and subsequent addition of O_2. The peroxy radicals formed decompose to ~80% by C-C bond cleavage followed by elimination of inorganic phosphate and only to ~20% by direct dephosphorylation. The relevance of these results with respect to the radiolysis of DNA is discussed. (DE)

26133 ESR STUDY OF THE ANION RADICALS OF 5-NITROPYRIMIDINES; CONVERSION TO IMINOXY RADICALS. Sevilla, M. D.; Clark, C.; Failor, R. (Oakland Univ., Rochester, MI). Radiat. Res.; 65: No. 1, 29-40(Jan 1976).

The anion radicals of a number of 5-nitropyrimidines have been investigated by ESR spectroscopy. The anions are formed by electrolysis in dimethylformamide and by electron attachment in aqueous glasses, 12 M LiCl-D_2O and 8 M NaOD. The electrolysis of 5-nitrouracil and 5-nitro-6-methyluracil results in relatively stable anion radicals. The results for 5-nitrouracil give evidence for two or perhaps three anions which differ only by the degree of ring nitrogen protonation. The results for 5-nitro-6-methyluracil suggest that the nitro group of the anion is twisted so that it is coupled only weakly to the ring pi-electron system. The anions of 5-nitrouracil, 5-nitroorotic acid, 5-nitrobarbituric acid, and 5-nitro-6-methyluracil have been produced in the alkaline and neutral aqueous glasses. The anisotropic spectra found have been analyzed with the aid of computer simulations which assume axial symmetry. For example, the analysis of the spectrum of 5-nitrouracil anion in 12 M LiCl yields A/sub parallel//sup N/ equals 33; A/sub perpendicular to//sup N/ equals 5, a_e/sup H/ equals 5,5 G, g/sub parallel/ equals 2,0016, and g/sub perpendicular to/ equals 2,0059. A concentration dependence in the splittings is noted and discussed. Ultraviolet photolysis of the anions of 5-nitro-6-methyluracil and 5-nitrobarbituric acid results in the formation of iminoxy radicals. Mechanisms of formation of the iminoxy radicals are discussed and results found in this work are compared to results found in single crystals and aqueous solution. (auth)

26134 gamma-IRRADIATION OF LIMA BEAN PROTEASE INHIBITOR IN DILUTE AQUEOUS SOLUTIONS. Lynn, K. R.; Raoult, A. P. D. (National Research Council of Canada, Ottawa). Radiat. Res.; 65: No. 1, 41-49(Jan 1976).

Two chromatographically separated fractions of lima beans protease inhibitor were irradiated under atmospheres of nitrogen, oxygen, and nitrous oxide and assayed for residual inhibitory capacity toward beta-trypsin and alpha-chymotrypsin. Conventional exponential losses were observed under the conditions studied. The amino acid compositions of the inhibitors were also monitored after radiolysis. The results obtained showed that apparently minor differences in the three-dimensional structures of the inhibitors were sufficient to influence significantly the rates of destruction of their inhibitory capacities. Further, the modes of action of radiation on the inhibitors is complex: No simple relation between loss of biological activity and destruction of amino acid residues pertains. (auth)

26135 EFFECTS OF GAMMA IRRADIATION ON THE STRUCTURE AND FUNCTION OF HUMAN HEMOGLOBIN. Szweda-Lewandowska, Z.; Puchala, M.; Leyko, W. (Univ., Lodz, Poland). Radiat. Res.; 65: No. 1, 50-59(Jan 1976).

In this paper physicochemical and functional properties of irradiated aqueous hemoglobin solutions are presented. HbO_2 solutions (5 percent) were irradiated in air with doses ranging from 0,5 to 5 Mrad at the efficiency of 1 Mrad/hr. At doses exceeding 1 Mrad, coagulation of small amounts of protein was observed. Hemoglobin which remained in the solution consisted of a mixture of HbO_2 and MetHb. At doses of 4 and 5 Mrad the presence of hemochromogen was established. The appropriate hydrodynamic parameters—molecular weight, sedimentation constant, and limiting viscosity value—do not differ from the control values up to a dose of 1 Mrad. At greater doses sedimentation constants and the limiting viscosity number increase. The decrease in the values of the second virial coefficient and the electrophoretic behavior in polyacrylamide gel suggest some changes in the electric charge of the molecules. Simultaneously, a considerable part of the molecules exhibits an increased affinity for oxygen and a decreased heme–heme interaction. (auth)

26136 ULTRAVIOLET PHOTOINACTIVATION OF GALACTOSYLTRANSFERASE. Protection by Substrates. Clymer, D. J.; Geren, C. R.; Ebner, K. E. (Univ. of Kansas, Kansas City). Biochemistry; 15: No. 5, 1093-1097(9 Mar 1976).

Galactosyltransferase was irreversibly inactivated upon exposure to ultraviolet light and the rate of inactivation followed apparent first-order kinetics. Significant protection against inactivation was observed in the presence of various combinations of substrates. UDPgalactose and Mn^{2+} together gave the most protection. Amino acid analyses revealed the loss of 1 mol of tryptophan per mol of galactysyltransferase upon ultraviolet photoinactivation. Further evidence for an essential tryptophan was provided by difference spectra and by inactivation with 2-hydroxy-5-nitrobenzyl bromide and protection against this reagent by Mn^{2+} and UDPgalactose. The protection by UDPgalactose and Mn^{2+} was greater than that provided by UDPgalactose alone. Since Mn^{2+} provided no protection by itself, this suggested that the formation of the galactosyltransferase–Mn^{2+}–UDPgalactose complex caused a conformational change which was responsible for the observed protection of the essential tryptophanyl residue. (auth)

Radiation Effects on Cells

Refer also to abstracts 26128 and 27818.

26137 (ERDA-tr-93) BIOLOGICAL CONSEQUENCES OF NUCLEAR WEAPONS TESTS. Mehring, C. E. 1972. Translation of German Report. (CONF-7209135-1). 15p. Dep. NTIS $3.50.

From 18th international convention for the diseases of civilization, nutrition and food conditions; Berlin, German, Federal Republic of (F. R. Germany) (16 Sep 1972).

Data on leukocyte values of two million residents of the Federal Republic of Germany during 1959 to 1966 are reviewed. The individuals included both normal people and patients during illness. Data on the content of fallout ^{90}Sr in human bones sampled during the same time period are also reviewed. The relationship of fallout ^{90}Sr to leukopenia is discussed. (CH)

26138 (ORO-4761-4) REPETITIOUS NATURE OF REPAIRED DNA IN MAMMALIAN CELLS. Progress Report, June 1, 1975–May 31, 1976. Meltz, M. L. (Southwest Foundation for Research and Education, San Antonio, Tex. (USA)). 1976. Contract AT(40-1)-4761. 77p. Dep. NTIS $5.00.

The specific activity of DNA isolated from cultured mammalian cells labeled with tritiated thymidine was determined for 20 minute intervals beginning at different times post-uv irradiation, during the period in which post-replication repair is presumed to occur. It was concluded that the radioactivity incorporated into the DNA synthesized at different times post-uv irradiation, during the period of presumed post-replication repair, is uniformly distributed throughout the genome. (auth)

26139 (SGAE-2469) ACTION OF SOME DRUGS ON ENZYMES INVOLVED IN DNA-REPAIR AND SEMICONSERVATIVE DNA-SYNTHESIS. Wawra, E.; Klein, W.; Kocsis, F.; Weniger, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Jul 1975. 11p. (CONF-7506119-1; BL-144/75). Dep. NTIS (US Sales Only) $4.50.

From symposium on interaction of radiation with drugs; Edinburgh, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (30 Jun 1975).

Different antirheumatic and cytostatic drugs were tested by measurement of thymidine incorporation into DNA of cultured spleen cells during either DNA synthesis or repair after γ- or uv-irradiation. DNA synthesis was inhibited by vinblastine and isonicotinic acid hydracide and DNA repair, after γ-irradiation, was inhibited by a mixture of penicillin-G and procaine-penicillin-G or cyclophosphamide, phenylbutazone, procarbazine, or nalidixic acid. (auth)

26140 CALCULATION OF THE LET IN THE QUANTITATIVE MODEL OF CELL INACTIVATION. Barsukov, V. S.; Malinovskii, O. V.; Maslov, M. A. pp 11-14 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

The basic assumptions of the quantitative model of cell inactivation are outlined. In accordance with the theory the interphase chromosomes are the target for the radiation. The relation for the dose dependence of the survivability is obtained by applying the hit principle to the target considered. (JSR)

26141 MICRODOSIMETRIC ANALYSIS OF THE RBE OF 14-MeV NEUTRONS. Videnskii, V. G.; Pitkevich, V. A.; Farnakeev, V. V. pp 25-28 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

The use of the concept of one sensitive volume and a given threshold energy (Rossi concept) for the interpretation of the RBE of neutrons for mammalian cells was studied. Experimentally obtained increment spectra of the specific energy were used as the initial data. The distribution functions for the specific energy were determined. Theoretical survival curves were calculated for different values of the threshold energy for 14 MeV neutrons and 200-keV x rays. A comparison of the curves showed that the RBE of neutrons at large doses and comparatively low survival levels was less than that of x rays. Such a relation, established experimentally for viruses and bacteria, does not correspond to the facts for mammalian cells and thus indicates the non-applicability of this model for explanation of the effects of ionizing radiation on mammalian cells. (JSR)

26142 POSSIBILITY OF SIMULATING THE DOSE-EFFECT CURVE ON THE BASIS OF THE INDEPENDENT RECOVERY MODEL. Gubin, A. T.; Kovalev, E. E.; Sakovich, V. A. pp 36-40 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

The possibility of a cell model description of G(Z), the probability of the realization of an effect during the absorption of energy Z, on the basis of the concept of independent recovery of the primary hit is studied. Comparison of the results obtained with experimental data show that for a description of the process of the development of radiation sickness at large LET values, the independent recovery model is not valid. Possible improvements to make the model correlate more closely with experimental data are proposed. (JSR)

26143 RELATIVE PROBABILITY OF DOUBLE AND SINGLE BREAKS IN THE DNA MOLECULE AS A FUNCTION OF THE CHARACTER OF THE RADIATION. Kalashnikov, N. P.; Dystsov, V. N.; Ryazanov, M. I. pp 48-50 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

The disagreement in the evaluation of the probability of radiation-induced double and single breaks in the DNA molecule in previously reported experimental studies can be caused by the inadequacy of the simplistic mechanism of double break formation and by the different experimental techniques used by different groups. It is also the contention of the present study that in the interpretation of experimental data on the ratio of double and single breaks it is necessary to consider that breaks can be caused not only by the primary ionizing radiation, but secondary ionization electrons. An expression is derived for the relationship between the probability of double and single breaks. (JSR)

26144 DETERMINATION OF POSSIBLE FORMS OF TARGETS AND SPECIFIC DEFINITION OF THE HIT CONCEPT FROM AN ANALYSIS OF THE DEPENDENCE OF THE RBE ON THE SPATIAL DISTRIBUTION OF ABSORBED ENERGY. Kapul'tsevich, Yu. G.; Petin, V. G. pp 50-54 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

An analysis of the dependence of the RBE on the LET led to the conclusion that sufficiently satisfactory conclusions can be made on the physical nature of hits and possible target forms. This makes it possible to explain the effects of radiation with different LET on different biological objects. The data obtained can be used for the formulation of computational methods for microdosimetry. (JSR)

26145 EFFECT OF THE MICRODISTRIBUTION OF ABSORBED ENERGY ON THE DOSE EQUIVALENT OF PROTONS. Lomanov, M. F.; Reznik, B. I.; Shimchuk, G. G.; Yakovlev, R. M. pp 64-68 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

The study of the changes of the biological effectiveness of protons as a function of LET (without comparison with effects from γ sources) makes it possible under comparable conditions to obtain data on the effects of beta electrons on biological objects. The energy loss theory gives a simple expression for the RBE of rarely ionizing radiation, dependent on only one parameter, the limiting energy of the effectively damaging microvolume of delta electrons. Interactions with the K shell of light atoms and the formation of Auger electrons have the most significance. Study of questions on electron equilibrium and the equilibrium of secondary particles during nuclear interactions of protons makes it possible to isolate the equilibrium part of the dose and the variable part, strongly dependent on the experimental conditions. The conditions for electron equilibrium are easily reestablished if the object is shielded by a thin layer of a tissue-equivalent substance. For corrections for the secondary nuclear radiation it is necessary to measure their composition and spectra. (JSR)

26146 HIT AND TARGET PRINCIPLES IN RADIOBIOLOGY. Savich, A. V.; Shal'nov, M. I. pp 91-98 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

The hit principle is the physics principle of discreteness and statistics of the interaction of radiation with matter and the target principle is the biological principle of the structural-functional heterogeneity of living organisms. The basic factors correlating these two principles with that of microdosimetry are outlined in tabular form and discussed. (JSR)

26147 ACCELERATION OF AGEING PROCESS BY IONIZING RADIATION. Rose, H. (Humboldt-Univ., Berlin). Radiobiol. Radiother.; 16: No. 5, 589-594(1975). (In German)

Tissue cultures were prepared of spleen and renal cortex from rats of various ages. Cell proliferation was retarded in cultures from older animals and in cultures from x-irradiated animals. Comparisons of effects of aging and effects of radiation on cells in tissue cultures are discussed. (HLW)

26148 RESPONSE OF PERIPHERAL BLOOD AND BONE-MARROW TO COMBINED IRRADIATION. Jakovleva, N. G.; Zorno, L. Ya. Radiobiol. Radiother.; 16: No. 5, 565-570(1975). (In German)

This paper presents the data on the dynamics and morphological changes in the peripheral blood and incidence of the aberrant mitoses in bone marrow after x-irradiation together with the

administration of ^{90}Sr and ^{144}Ce. The mixed exposure is shown to cause an acute radiation disease changing gradually into a chronic one. Three periods in the development of morphological changes in the peripheral blood have been found: the first period reflected the changes due to external irradiation; the second — the period of normalization — is relatively short; and in the third period the summation of the effects of external and internal radiations occurred. In the development on the cytological reaction of bone marrow two phases were observed: the first phase was determined by the external radiation effect, the second one presented the nature of the changes induced by internal exposure. (auth)

26149 POSSIBILITIES OF MODIFICATION, THE INTRACELLULAR DIGESTION IN THE PHYSIOLOGY AND IN THE COURSE OF IRRADIATION SYNDROME. Kocmierska-Grodzka, D. (Pharmakologischen Institut der Medizinischen Akademie, Bialystok, Poland). Radiobiol. Radiother.; 16: No. 5, 553-563(1975). (In German)

Cell organelles, lysosomes and their hydrolases which form the endocellular digestive system are described. The importance of the modification of the activity of lysosomal enzymes under the influence of some inhibitors, activators or factors affecting lysosomal membrane integrity for the digestion of endo- or exogenic substrates in physiology and after irradiation is discussed. (auth)

26150 RESPONSE OF CHINESE HAMSTER OVARY CELLS TO FAST NEUTRON RADIOTHERAPY BEAMS. I. Relative Biological Effectiveness and Oxygen Enhancement Ratio. Gragg, R. L.; Humphrey, R. M.; Meyn, R. E. (Univ. of Texas Health Science Center, Houston). Radiat. Res.; 65: No. 1, 71-82(Jan 1976).

The relative biological effectiveness (RBE) and oxygen enhancement ratio (OER) were determined for fast neutron beams produced by both 16-MeV and 50-MeV ^{2}H on Be at the Texas A and M Variable Energy Cyclotron (TAMVEC). These beams have average neutron energies of 7 and 21 MeV, respectively. The biological system used in these experiments was Chinese hamster ovary cells in tissue culture. The results indicated that although the RBE of the 21-MeV beam was about 15 percent lower than that for the 7-MeV beam at 0.1 percent survival there was no change in RBE for either beam with depth in a tissue-equivalent phantom. The OER of the 7-MeV beam was found to be 1.5 +- 0.3 and the 21-MeV beam had an OER of 1.2 +- 0.2, which resulted in gain factors of 1.7 and 2.1, respectively, when compared to ^{60}Co gamma rays (OER equals 2.5). No variation in OER with depth was detected. It was concluded that the 21-MeV TAMVEC beam should be as applicable to radiotherapy from the radiobiological point of view as a 7-MeV beam. (auth)

26151 CHEMICAL PROTECTION AGAINST RADIATION-INDUCED DNA SINGLE-STRAND BREAKS IN CULTURED MAMMALIAN CELLS. Antoku, S. (Hiroshima Univ.). Radiat. Res.; 65: No. 1, 130-138(Jan 1976).

Protection by mercaptoethylamine (MEA) and thiourea against the induction of DNA single-strand breaks by irradiation under aerated and anoxic conditions and in the frozen state was studied with cultured mouse leukemic L5178Y cells. The results were compared with those previously obtained for colony-forming ability. Under aerated conditions, good correlation was observed between protection against DNA strand breaks and cell lethality over a wide range of concentrations of the protective agents. Under anoxic conditions, DRF values varied from 1.0 to 1.6 for 50 mM MEA and from 1.0 to 1.8 for 100 mM thiourea over the dose range studied. Protection against DNA strand breaks was observed only for doses greater than 20 krad. Protection against DNA strand breaks after irradiation at $-196^{0}C$ was essentially the same as that for cell lethality. MEA interfered with the rejoining of DNA strand breaks induced by irradiation under aerobic conditions, even when it was removed before the postirradiation incubation. (auth)

26152 USE OF TRACK-END ALPHA PARTICLES FROM ^{241}Am TO STUDY RADIOSENSITIVE SITES IN CHO CELLS. Datta, R.; Cole, A.; Robinson, S. (Univ. of Texas System Cancer Center, Houston). Radiat. Res.; 65: No. 1, 139-151(Jan 1976).

Monolayers of CHO cells placed on membrane filters were irradiated with alpha particles from a ^{241}Am source. Particle penetration into the cells was controlled by placing the cell sample at various distances from the source. Dosimetric and spectrometric measurements were performed at comparable positions using a parallel plate ionization chamber and a scintillation crystal spectrometer. Cell survival, as measured by conventional cloning techniques, was single hit in form. A pronounced minimum in mean lethal dose of 29 rad was observed for alpha particle beams that penetrated only about 3 mu m into the cell. A pronounced maximum in inactivation cross section of 90 mu m^2, equal to about half the projected area of the nucleus, occurred for beams that penetrated only 5 to 7 mu m into the cell. Thus, a single alpha particle penetration several micrometers within the cell nucleus was effective in killing the cell, while fully penetrating beams were actually less efficient; the latter beams required multiple particle traversals and about three times the cell dose to achieve the same effect. These results support the proposal that radiosensitive sites are located in a thin peripheral region of the nucleus. (auth)

26153 POLYFUNCTIONAL RADIOSENSITIZERS. I. Effects of a Nitroxyl Biradical on the Survival of Mammalian Cells in Vitro. Cooke, B. C. (Inst. of Cancer Research, Sutton, Eng); Fielden, E. M.; Johnson, M.; Smithen, C. E. Radiat. Res.; 65: No. 1, 152-162(Jan 1976).

The effect of bis(2,2,6,6-Tetramethyl-1-oxyl-4-piperidinyl) succinate (Ro-03-6061) on the survival parameters of V-79 Chinese hamster cells, irradiated under hypoxia, has been compared with related monofunctional nitroxyl compounds. The biradical is more effective in reducing the D_0 value than the three monoradical nitroxyls tested. It also removed the shoulder in asynchronous cell survival experiments, although this effect did not occur in the presence of oxygen. The shoulder for the survival curve for cells irradiated during late S phase was also reduced. Possible mechanisms for its actions are discussed in terms of the bifunctionality of the compound and the potential of such a sensitizer in radiotherapy is emphasized. (auth)

26154 RBE AS A FUNCTION OF NEUTRON ENERGY. II. Statistical Analysis. Kellerer, A. M.; Hall, E. J.; Rossi, H. H.; Teedla, P. (Columbia Univ., New York). Radiat. Res.; 65: No. 1, 172-186(Jan 1976).

An experimental study of the relative biological effectiveness of neutrons of various energies for the inactivation of hamster cells has been reported previously; the present article contains a detailed statistical analysis of the data. Repeated determination of X-ray survival curves made it possible to assess the statistical fluctuations of survival rates. Within individual experiments the statistical variations are close to those expected on theoretical grounds. However, between experiments substantial variations in the reaction to X rays occur; these fluctuations can be approximately described by dose-modifying factors. An idealized survival curve for X-irradiation has been derived. The survival curves for neutrons have been compared to the linear–quadratic dose–effect relation and the two coefficients in this equation have been derived together with their joined confidence regions. The linear coefficient for neutrons reaches a maximum for neutron energies of several hundred thousand electron volts; the coefficient of the quadratic component is increased at neutron energies below 1 MeV. The dependence of RBE on neutron energy and on neutron dose is derived from the estimated dose–effect relations. In addition, the more rigorous nonparametric method is used to derive confidence intervals for the RBE of neutrons. (auth)

26155 HUMAN CELL SURVIVAL AS A FUNCTION OF DEPTH FOR A HIGH-ENERGY NEON ION BEAM. Raju, M. R. (Los Alamos Scientific Lab., NM); Blakely, E.; Howard, J.; Lyman, J. T.; Kalofonos, D. P.; Martins, B.; Yang, C. H. Radiat. Res.; 65: No. 1, 191-194(Jan 1976).

Cultured human kidney cells were irradiated while suspended in a gelatin cylinder using a 400-MeV/u neon ion beam produced by the Berkeley BEVALAC. The Bragg peak was transformed to a width of 4 cm with a ridge filter, and cell survival (colony-forming ability) was determined as a function of depth and dose. A cell survival curve in the broadened peak region appeared to be exponential, and RBE values in the peak and plateau regions were approximately 3.0 and 1.8, respectively, at the 10 percent survival level. Thus, the results indicate that the biological effect is enhanced even when the narrow peak is broadened. The secondary particles (ions lighter than neon and neutrons) produced by neon ions do not cause much cell killing beyond the range of neon ions and, thus, do not seem to be a limiting factor for the use of neon ion beam in radiotherapy. (auth)

Radiation Effects on Microorganisms

Refer also to abstract 27818.

26156 CONTRIBUTION OF THE RECOVERY EFFECT TO THE SURVIVAL OF YEAST CELLS DETERMINED EXPERIMENTALLY. Kapul'tsevich, Yu. G.; Petin, V. G. pp 54-57 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow: Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124--.

Two groups of yeast cells, budding at different times, were exposed to doses of 43 and 150 krad radiation and the survival rates were determined. The survival of the cells placed on the nutrient media within 3.5 hrs after irradiation was significantly higher than that of cells not placed in a nutrient medium until 5 hrs after irradiation. The experimental results were compared with calculated results with good agreement in the high dose range, but with the calculated curve being somewhat higher in the low-dose range. (JSR)

26157 UV MUTAGENESIS IN RADIATION-SENSITIVE STRAINS OF YEAST. Lawrence, C. W.; Christensen, R. (Univ. of Rochester School of Medicine and Dentistry, NY). Genetics; 82: No. 2, 207-232(Feb 1976).

The yeast Saccharomyces cerevisiae appears to possess a single mutagenic or error prone pathway for the repair of uv damage, probably involving the functions of at least seven genes; rev1, rev2, rev3, rad6, rad8, rad9, and rad18. Strains carrying rad6 are the most sensitive to the lethal effects of uv light in this group and double mutants carrying rad6 and either rev1, rev3, rad9 or rad18 are no more sensitive than this single mutant strain. Rev3 rad6 double mutant diploids failed to show any uv-induced reversion of the normally highly revertible ochre allele cyc1-9, even though a total of more than 2.5×10^8 viable cells was examined, suggesting that strains of this kind are entirely uv-immutable; spontaneous revertants could be recovered, however. The rad6 and rev3 gene products would appear to be necessary for all kinds of mutagenic events at all sites within the genome, but the products of the other genes that act in the error-prone pathway have a more restricted role and are involved in the production of only some kinds of mutations. It is suggested that such selectivity arises from the interaction of some repair enzymes with specific nucleotide sequences. (auth)

26158 ISOLATION AND CHARACTERIZATION OF AMBER SUPPRESSORS IN YEAST. Liebman, S. W.; Sherman, F.; Stewart, J. W. (Univ. of Rochester School of Medicine and Dentistry, NY). Genetics; 82: No. 2, 251-272(Feb 1976).

Nonsense suppressors were obtained in a haploid yeast strain containing eight nutritional mutations, that are assumed to be amber or ochre, and the cyc1-179 amber mutation that has a UAG codon corresponding to position 9 in iso-1-cytochrome c. Previous studies established that the biosynthesis and function of iso-1-cytochrome c is compatible with replacements at position 9 of amino acids having widely different structures. UV-induced revertants, selected on media requiring the reversion of one or two of the amber nutritional markers, were presumed to contain a suppressor if there was the unselected reversion of at least one other marker. The 1088 suppressors that were isolated could be divided into 78 phenotypic classes. Only 43 suppressors of three classes caused the production of more than 50 percent of the normal amount of iso-1-cytochrome c in the cyc1-179 strain. Genetic analyses indicated that all of these highly efficient amber suppressors are allelic to one or another of the eight suppressors which cause the insertion of tyrosine at ochre (UAA) codons. Furthermore, only tyrosine has been identified at position 9 in iso-1-cytochrome c in cyc1-179 strains suppressed with these efficient amber suppressors. (auth)

26159 GIANT CELLS FROM SACCHAROMYCES UVARUM GROWN AFTER X-IRRADIATION. Rink, H.; Partke, H. J. (Bonn Univ. (F. R. Germany). Abt. fuer Strahlenbiologie). Radiat. Environ. Biophys.; 12: No. 2, 119-125(Jul 1975).

6 figs.; 1 tab.; 13 refs.

Yeast cells, Saccharomyces uvarum, were irradiated with x rays and grown in liquid suspension. Glucose as the only carbon source was limited to 12.5 mM. Under these conditions giant cells are formed. Cell number, glucose utilization, ethanol production, and oxygen consumption are measured during the time of growth. The mean weight of single cells in the stationary phase increases up to 75 krad and is not due to an uptake of water. In irradiated cultures oxygen consumption and glucose utilization per cell are higher than in control cells. The data demonstrate that synthesis and energy metabolism during the formation of non-dividing, radiation-induced giant cells is increased. (DE)

26160 VARIATIONS IN SURVIVAL AND "PETITE" MUTAGENESIS INDUCED BY ULTRAVIOLET LIGHT DURING THE MEIOTIC CYCLE OF SACCHAROMYCES CEREVISIAE. Hottinguer-de Margerie, H.; Moustacchi, E. (Institut du Radium, 75-Paris (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 22, 2617-2620(9 Jun 1975). (In French)

Cyclic variations in sensitivity to killing and cytoplasmic petite ρ induction by ultraviolet light occur during the meiosis of Saccharomyces cerevisiae. Maximal sensitivity to killing coincides with the period of meiotic nuclear DNA synthesis. Cyclic fluctuations in petite induction could not be correlated with known meiotic events and the pattern could vary temporarily from batch to batch. A dark liquid holding of irradiated cells aided the repair of lethal lesions but on the other hand an enhancement of petite induction was observed at all meiotic stages. (FR)

26161 TOXIC EFFECTS UPON BACTERIA OF PHOSPHATE-BUFFERED SALINE EXPOSED IN A HIGH-FREQUENCY ARGON DISCHARGE. Brustad, T. (Norsk Hydro's Inst. for Cancer Research, Oslo); Boye, E.; Wold, E. Radiat. Res.; 65: No. 1, 98-110(Jan 1976).

An electrodeless Ar- and H_2-gas discharge apparatus has been used to expose suspensions of E. coli, K-12. H, OH, and e/sub aq/$^-$ are formed in the surface layer of the Ar-exposed suspension and attack the cells predominantly from outside. When cells are exposed in the Ar-discharge in phosphate-buffered saline (pH equals 6.8), repair-proficient and repair-deficient strains are inactivated with about equal efficiency, with no detectable damage in terms of single-strand breaks either in intracellular phage lambda-DNA or in the bacterial DNA. The lethal effect is shown to be caused almost entirely by an OH-induced toxic product formed from phosphate-buffered saline. The toxic product is not yet identified, but its long lifetime and nonvolatility suggest that it may be an oxidation product of Cl^-, like HClO. When cells are exposed in the argon discharge setup in phosphate buffer without NaCl, inactivation is negligible. This suggests that the primary action of extracellular OH-radicals is insignificant for the X-ray-induced indirect effect. (auth)

Radiation Effects on Plants

26162 (AED-CONF-75-358-001) THE INFLUENCE OF STORAGE ON SODIUM AZIDE TREATED BARLEY SEEDS AND ON THE EFFICIENCY OF THE CHEMOMUTAGEN. Walther, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Botanik und Mikrobiologie). 1975. 9p. INIS.

From 3rd international barley genetics symposium; Garching, F. R. Germany (7 Jul 1975).

With abstract. Available from ZAED.

Sodium azide (NaN_3) is known as one of the most effective chemomutagens in barley. In our experiments there was found a mutation rate (number of chlorophyll-defect-mutations/100 M_1-spike progenies) of about 30 to 10% confirming the results of other investigations. Post-X-irradiation storage of seeds resulted in an increase of the initially induced radiation damage, being higher in radiosensitive cultivars than in less sensitive ones. After treatment with sodium azide the storage of barley seeds up to nine months under normal conditions (18 to 20°C, in air) resulted in a decrease of germinability and an increase of the growth depression of the first leaf. In cytological investigations immediately after the treatment as well as after storing the seeds for 12 months under normal conditions we did not find any chromosomal aberrations during the first mitosis. Furthermore, the efficiency of NaN_3 on seed germination and growth of the primary leaf were tested after storing the NaN_3-solution for nine months in a refrigerator at +5°C. This storage did not lead to any change in the effectiveness of the chemomutagen. (DE)

26163 (AED-CONF-75-358-002) A RECIPROCAL TRANSLOCATION IN BARLEY AFTER GAMMA IRRADIATION OF DRY SEEDS. Zecevic, L.; Popovic, A.; Maksimovic, D. 1975. 13p. INIS.

From 3rd international barley genetics symposium; Garching, F. R. Germany (7 Jul 1975).

With abstract. Available from ZAED.

Meiotic studies showed the presence of a reciprocal translocation in the variety Manon, the M_2-line No. 32 (dose of 15,000 R-units). A ring of four chromosomes was observed in 29.80% of analyzed PMC's at metaphase I. This translocation ring had a closed or open shape. In some cases J-shaped rings were found. Pollen sterility of this line amounted to 27.63%. Different number of univalents, ranging from two to six, were present in 16.33% of PMC's at metaphase I, with an average of 0.47 per PMC. The agglutination of chromosomes at metaphase I was a frequent phenomenon in this line. The laggard chromosomes were found at anaphase I. The phenomenon of chromosome agglutination and the occurrence of univalents were noticed at metaphase I in the M_2-line No. 53 (variety Ager, dose of 15,000 R-units). The rings of 4 chromosomes were absent in this line. Pollen sterility in this line amounted to 29.82%; univalents were found in 11.33% of PMC's only, with an average of 0.31 univalent per PMC. (DE)

26164 EFFECTS OF ROASTING TEMPERATURES AND γ IRRADIATION ON THE CONTENT OF CHLOROGENIC ACID, CAFFEIC ACID, AND SOLUBLE CARBOHYDRATES OF COFFEE. Deshpande, S. N.; Aguilar, A. A. (Puerto Rico Nuclear Center,

Mayaguez). Int. J. Appl. Radiat. Isot.; 26: No. 11, 656-661 (Nov 1975).

Two varieties of Puerto Rican coffee, Coffee canephora L. var. Robusta, and Coffee arabica L. var. Borbon, were subjected to four different doses or radiation and roasted at two different temperatures. Aqueous extracts of the ground coffee beans were analyzed for chlorogenic acid and caffeic acid at 324 nm and 360 nm wavelength settings, respectively. Samples subjected to the roasting treatments in conjunction with irradiation treatments were treated with basic lead acetate prior to the colorimetric analyses in order to eliminate interfering substances. The total carbohydrate content was also determined by colorimetric techniques with anthrone reagent. The total nitrogen content of the pulverized samples was determined by the micro-Kjeldahl method. While roasting treatments caused a reduction in the concentrations of the chlorogenic acid, caffeic acid, and the carbohydrates, the radiation treatments increased the concentrations of soluble carbohydrates without affecting the concentrations of chlorogenic acid or caffeic acid. It therefore appears that radiation treatments seem to cause degradation of the acid-polysaccharide complexes liberating soluble sugars. There were no noticeable changes in the total content of nitrogen caused by roasting or the radiation treatments as indicated by the statistical analysis employing the split plot design. (auth)

26165 VIL'NI RADIKALI V OPROMINENIKH ROSL'NAKH TA NASINNI. (Free Radicals in Irradiated Plants and Seeds). Bidzilya, M. I. Kiev; Vidavnitstvo Naukova Dumka (1972). 209p.

An in-depth analysis is made of free radicals in irradiated seeds and plants. The topics discussed are the nature of the free radicals, methods of studying free radicals, induction of free radicals in plants and seeds, effect of various factors on the free radical state, effect of radioprotective agents on the induction of free radicals, paramagnetic properties of melanin, nature of the free radicals, and implications for additional study. (JSR)

26166 RADIATION INDUCED PARAMAGNETIC CENTERS IN DRY SEEDS OF LEGUMES. Saha, J.; Jana, M. K. (Indian Inst. of Tech., Kharagpur. Applied Botany Section). Atomkernenergie; 26: No. 2, 143-144(1975).

3 figs.; 6 refs.

Dry seeds of Vicia faba, Phaseolus mungo and Trigonella foenum-graecum were irradiated with x rays and paramagnetic susceptibility measurements were done at 30°C in a magnetic microbalance. The amount of free radicals produced was different in these species whereas the decay patterns of radiation induced radicals were more or less similar. There was considerable reduction in paramagnetic susceptibility of seeds irradiated under anoxic conditions than in air. The x ray induced free radicals measured in whole seeds, embryo, and endosperm of broad bean (Vicia faba) showed that this amount was far greater in embryo than in endosperm. (DE)

Radiation Effects on Animals

Refer also to abstract 26144.

Man

Refer also to abstracts 25973, 25975, 25982, 25983, 26007, and 27818.

26167 (AD/A-005898) THE EFFECT OF EXTREMELY LOW FREQUENCY RADIATION ON HUMAN PERFORMANCE: A PRELIMINARY STUDY. Medical Research Progress Report. Gibson, R. S.; Moroney, W. F. (Naval Aerospace Medical Inst., Pensacola, Fla. (USA)). Aug 1974. 24p. (NAMRL-1195). NTIS $3.25.

Interest in the development of an extremely low frequency (ELF) communications system for naval use has resulted in a program to determine the effects of such fields on man. This report represents part of pilot level effort to develop a set of tests and procedures for determining whether ELF fields have any measurable effects on human memory and psychomotor functions. None of the tests exhibited significant performance decrements under the gross analytical conditions. The Wilkinson Adding Task exhibited significant performance decrements during the second of two testing sessions while being exposed to the ELF radiation. One of the Response Analysis Tester (RATER) conditions exhibited a significant improvement in performance. One subject had a significantly bad session in which his performance declined on 6 out of 7 measures; however, this performance appeared to be unrelated to other psychological or physiological data. In view of the large number of statistical analyses performed on a limited amount of data, the few significant performance decrements must be interpreted with extreme caution. They identify techniques to be replicated in future research and nothing more. Individual differences in test performance were large, any effects due to the exposure to ELF magnetic fields were small; consequently, special consideration should be given to the possibility of using an exposure-reexposure experimental design in any future experiments. (GRA)

26168 (AED-CONF-74-725-000 (Vol. 2), pp 493-499) ARE NATURAL RADIOACTIVE MATERIALS DANGEROUS. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The different radiation loads caused by natural and artificial radionuclides are compared in this paper. These examples will serve to illustrate that the problem of population exposure to radiation can only be solved in consideration of all components and to show which effects of the radiation from natural sources are of special importance in this connection. (DE)

26169 (AED-CONF-74-725-000 (Vol. 2), pp 500-517) RADIATION EXPOSURE OF THE POPULATION IN BUILDINGS. Kolb, W. 1974. (In German)

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

A 1958 estimation of the natural radiation load of the population of the FRG is based on relatively few measurements of terrestric radiation, and no regard is paid to the fact that people in these latitudes spend most of the day in houses. In order to get a picture of the contribution of building materials to the total radiation exposure, the Federal Ministry of the Interior initiated a measuring program in which eight different scientific institutes participated. A first interim statement is now possible since dose rate measurements by a standard method have by now been performed in more than 10,000 dwellings. According to this statement, the mean local outdoor dose rate ranges from 4.7 μR/h in the administrative district of Suebia to 8.0 μR/h in Upper Franconia. The mean local indoor dose rate is lowest in Hamburg at 5.4 μR/h and highest in the Saar Territory at 11.9 μR/h. While mean outdoor and indoor dose rates are virtually the same in the Federal Lands Hamburg and Schleswig-Holstein, the indoor dose rates are about 60% higher than the outdoor dose rates in the Saar Territory, in the Palatinate, and in Lower Franconia. Yet even in the other regions the contribution of the radioactive tracer elements in building materials to the radiation exposure of the inmates of a house is non-negligible. Characteristic differences between different types of house and building materials are discussed in detail, and single values of buildings are presented which determine the range of the annual dose. (DE)

26170 (AED-CONF-74-725-000 (Vol. 2), pp 523-536) RADIOACTIVITY AND RADIATION EXPOSURE DUE TO CERAMIC WALL FACINGS WITH A COLOURED GLAZING CONTAINING URANIUM. Ludwieg, F.; Kunz, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

In 1971 a 25 m^2 wall panelled with tiles containing uranium was accidentally found in a 10 year old one-family house. During production of these ceramic tiles, uranium had been added to the glazing as a pigment in order to achieve a reddish-brown coloring. Measurements on one tile established a uranium content of about 4 mg/cm^2 in the surface glazing of about 0.1 mm thickness. Further studies provided information on the radionuclide composition, the abrasion resistance of the glazing, the intensity of the emitted α-, β-, and γ-radiation as well as on the dose rate and the resulting radiation load of the occupants of the house. The dose rate was 3 mrem/h on the surface of the wall facing, and 1 mrem/h was still measured in 1 m distance. These values by far exceed the normal dose rate due to natural radiation in buildings, which is about 0.01 mrem/h. More than 99% of this increased dose rate was due to the β-radiation emitted by the radioactive uranium daughters. The owner of the house was advised to cover

the wall with a wood panelling in order to reduce the radiation exposure in front of the tiled wall. (DE)

26171 (AED-CONF-74-725-000 (Vol. 2), pp 765-779) REVIEW OF PUBLICATIONS BY E. STERNGLASS REGARDING EPIDEMIOLOGICAL INVESTIGATIONS IN THE USA. Kriegel, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The statements made by E. Sternglass on the causal relationship between the exposure of humans to "fallout" radiation and infantile mortality are given a short review. His statements are checked with the aid of validated experimental data on the biological effects of incorporated fission products in general and the radiation effects on embryonal and foetal development as a function of the radiation dose in particular. The study aims especially on Sternglass' theory of infantile mortality in connection with ^{90}Sr in the "fallout" and with radioactive gases in the environment of nuclear power stations. Sternglass' request for epidemiological studies in the environment of nuclear facilities is discussed. (DE)

26172 (AED-CONF-74-725-000 (Vol. 2), pp 780-788) IONIZING RADIATION AS A CARCINOGENIC FACTOR IN OUR ENVIRONMENT. Oeser, H. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

Ionizing radiation is part of man's natural environment, with great variations around the globe. It has been in existence ever since man began to populate the earth. Ionizing radiation has become an indispensable means for the radiation therapy of M. Bechterew, there has been no positive proof of any risk, in particular of carcinogenic effects. Whole-body irradiation with higher radiation doses (= 200 + Rad) has lead to a higher incidence of malignant tumors in the Japanese survivors of the A-bomb. The author accounts for this fact with oncological and not with radiobiological explanations. (DE)

26173 (CONF-741182-) SCIENTIFIC COLLOQUIUM ON MEDICAL SUPERVISION OF WORKERS EXPOSED TO IONIZING AND NON-IONIZING RADIATIONS, 28-29 NOVEMBER 1974, BRUSSELS, BELGIUM. (Commission of the European Communities, Brussels (Belgium)). 1974. 223p.

From scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations; Brussels, Belgium (28 Nov 1974).

Separate abstracts were prepared for 11 papers. Eight were announced in Nuclear Science Abstracts, and 3 were announced in ERDA Energy Research Abstracts. (CH)

For abstracts of individual papers see: 26174-26178 and 26312-26314.

26174 (CONF-741182-, pp 10-27) PRACTICAL ORGANIZATION OF MEDICAL SUPERVISION FOR THE VARIOUS CATEGORIES OF EXPOSED WORKERS. Strambi, E. (C. N. E. N., Rome). 1974.

From scientific colloquium on medical supervision of workers exposed to ionizing and non ionizing radiations; Brussels, Belgium (28 Nov 1974).

In scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations. (Commission of the European Communities, Brussels (Belgium)).

Criteria for the pre-employment physical examination, routine examinations, and examinations after accidental radiation exposure of personnel employed at nuclear facilities are discussed. These criteria should relate to both the interpretation of the clinical examination results and to the assessment of other factors (psychological, socio-economic, etc.). The need for the content and programming of the medical examinations chosen by the authorized medical officer to be brought into line with those provided for by other public health services in the field of preventive medicine and the early detection of cancer is discussed. The occupational hazards due either to radiation or to other harmful agents must be investigated on an individual and overall basis. ICRP recommendations on general industrial medical practice are suggested as a guide. (CH)

26175 (CONF-741182-, pp 30-53) HEALTH CARE DURING REACTOR SHUT DOWN FOR MAINTENANCE, INSPECTION, AND REPAIR OF NUCLEAR POWER PLANTS IN THE NETHERLANDS. Wijker, H. (Gezondheidsbescherming, Arnhem, Netherlands). 1974.

From scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations; Brussels, Belgium (28 Nov 1974).

In scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations. (Commission of the European Communities, Brussels (Belgium)).

The health care for workers in nuclear power plants has medical-biological aspects and physical-technical ones. It requires a close collaboration between the medical doctor and the health physicist. A combination of prevention, supervision, and checks provides optimum health care. It includes plant design, medical examination, whole-body counting, dose reserve calculations, dose measurements, radiation supervision services, and physical and medical checks. Organization and experience in the Netherlands are discussed. (auth)

26176 (CONF-741182-, pp 56-81) MEDICAL FILE AND RECORD OF IRRADIATION. Mazaury; Sarbach. (CEA, Paris). 1974.

From scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations; Brussels, Belgium (28 Nov 1974).

In scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations. (Commission of the European Communities, Brussels (Belgium)).

According to the Law of 11-10-1946 setting up Industrial Medicine in France a medical file must be kept of each worker. Moreover, French legislation imposes heavy obligations on the industrial doctor responsible for the medical supervision of staff regularly exposed to ionizing radiations; these obligations apply, in particular, to the number of examinations to be carried out and the recording of medical data. It is a legal requirement that the complete case history of a worker occupationally exposed to ionizing radiations, be kept throughout the whole of his working life and for at least 30 years after he leaves the industry. The medical file contains the results of routine examinations and all clinical, paraclinical, biological, and toxicological examination which are of vital importance for preventing risks (industrial in general or nuclear) and for assessing the man's suitability for his activity. (auth)

26177 (CONF-741182-, pp 82-85) MEDICAL RECORDS AND RADIATION EXPOSURE CARDS. Vigan, C. (C. C. R., Ispra, Italy). 1974.

From scientific colloquium on medical supervision of workers exposed to ionizing and non-ionizing radiations; Brussels, Belgium (28 Nov 1974).

In scientific colloquium on medical supervision of workers exposed to ionizing and non-ionizing radiations. (Commission of the European Communities, Brussels (Belgium)).

The differences between conventional industrial medical records and those used for staff exposed to ionizing and nonionizing radiation are discussed. It is pointed out that the main difference is that certain areas are treated in more detail rather than that any new ones are used. The approved medical practitioner must gather enough relevant information to decide on the worker's suitability and also to determine his physical condition, normal or otherwise, and he must record it with enough detail to permit comparison with findings at later examinations. A great deal of importance is attached to the occupational medical history and to the detailed description of the workplace given by the person concerned, which often differs considerably from the information provided by management. Account-keeping of radiation doses administered for diagnostic or therapeutic purposes should be more strict. These are high doses and out of proportion with the very moderate ones from occupational exposure. (auth)

26178 (CONF-741182-, pp 86-100) MEDICAL RECORDS AND RADIATION EXPOSURE CARDS. Giubileo. 1974.

From scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations; Brussels, Belgium (28 Nov 1974).

In scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations. (Commission of the European Communities, Brussels (Belgium)).

Occupational exposure to ionizing radiations is authorized in accordance with the maximum permissible doses laid down for workers. Since these limits were adopted, it became necessary to record individual dosimetric data on special forms. Two general

tendencies have been observed for cases when the risk is connected with the use of x-ray generators and devices of industrial gammagraphy. For workers subject to regular control by an industrial medical officer, the dosimetric information is recorded side by side with the results of other additional examinations noted in the medical record. For other persons (such as radiologists and health personnel in general), dosimetric data often forms a separate source of information and as such are kept by the person responsible for physical monitoring. With the increasingly widespread use of radioisotopes in medicine, the health surveillance of exposed persons became more specialized, particularly in Nuclear Centres where the health personnel responsible for controlling hazards due to radiation drew up a new type of card which, apart from simply recording the dosimetric data, also gives various details of the type of protection used. (auth)

26179 (EUR-5397e) RADIATION PROTECTION MEASUREMENT: PHILOSOPHY AND IMPLEMENTATION. Selected Papers of the International Symposium Held at Aviemore, Scotland, 2–6 June 1974. Recht, P.; Lakey, J. R. A. (eds.). (Commission of the European Communities, Luxembourg. Directorate for Health Protection). 1975. 297p. (In French and English). (CONF-740603-). Directorate for Health Protection, Luxembourg.

The papers in the booklet are a selection from the proceedings of an International Symposium held by the U. K. Society for Radiological Protection in June 1974. The central theme was the philosophy of radiation protection measurement and its interpretation although some specific areas of health physics practice were included. The publication is the first wide circulation of the full text of some of the papers and has been made possible by the support of the Commission of European Communities. The papers selected for the publication were chosen to be either representative of the central theme or of wider interest. (auth)

For abstracts of individual papers see: 26028, 26033, 26180–26200, and 26298–26301.

26180 (EUR-5397e, pp 8-22) PHILOSOPHY OF MEASUREMENT IN RADIOLOGICAL PROTECTION: THE RECOMMENDATIONS OF THE ICRP REGARDING RADIATION MONITORING. Stewart, C. G.; Sowby, F. D. (International Commission on Radiological Protection, Sutton, Eng.). 1975.

From 2nd international conference on radiation protection–philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Some topics discussed are: history of the development of ICRP recommendations; aims of radiation protection in working environments; design of monitoring systems; ICRP recommendations regarding actual implementation of monitoring systems; use of Derived Working Limit (DWL) in assessing radiological safety; and importance of keeping records of monitoring results. (HLW)

26181 (EUR-5397e, pp 23-36) MAN REMS AND RISK. Mole, R. H. (Medical Research Council, Harwell, Eng.). 1975.

From 2nd international conference on radiation protection–philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Some topics discussed are: basic axioms of the science of radiological protection; varieties of biological effects and dose-response; hereditary effects; cancer; teratogenesis; relative importance of somatic and hereditary effects; and differing philosophies of risk estimation and of radiological protection. (HLW)

26182 (EUR-5397e, pp 37-43) TRACEABILITY FOR PROTECTION LEVEL MEASUREMENTS. Campion, P. J. (National Physical Lab., Teddington, Eng.). 1975.

From 2nd international conference on radiation protection–philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

In the United Kingdom the National Physical Laboratory is the focus for primary measurements in many metrological fields including that of ionizing radiation. Indeed such a hierarchical system has been in existence for radiotherapy levels of radiation for a number of years. In this scheme a number of radiotherapy hospitals in this country have been nominated as secondary standardizing centers and regularly send their instruments to the NPL for calibration. In turn, these instruments are used to calibrate instruments for other hospitals in the locality. Because this scheme has proved successful (and has in fact been used as a model by the World Health Organization for use on a global basis) it seemed logical to adopt a similar scheme for protection level measurements. Such a proposal was formally raised at the British Committee on Radiation Units and Measurements (BCRU), a committee which roughly parallels the ICRU on a national level. It was felt desirable that there should be some form of control over the secondary standardizing laboratories. The criteria include the following: laboratory staff; laboratory environmental conditions; laboratory equipment; records system; ability to provide adequate services to customers; measurement procedures; and measurement capability. (HLW)

26183 (EUR-5397e, pp 52-62) INTERPRETATION OF EXPOSURE IN TERMS OF PERMISSIBLE DOSES, INTAKES, AND ORGAN CONTENTS. Vennart, J. (Medical Research Council, Harwell, Eng.). 1975.

From 2nd international conference on radiation protection–philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The present recommendations of the International Commission on Radiological Protection concerning exposure to radioactive materials (ICRP Publication 2, 1959) are framed in terms of the derived limits maximum permissible body burden, MPBB, and maximum permissible concentrations in air and water, MPC_a and MPC_w. These have frequently been misused to infer that they represent true maxima for the radioactive content of the body and for the concentrations in air and water. For purposes of control of exposure of workers it would be more appropriate to recommend derived limits which are directly related to the Commission's basic limits on annual dose (ICRP Publication 9, 1966) namely values of the maximum permissible annual intake, MPAI, of a radionuclide by ingestion or inhalation. Also to recommend values of the derived air concentration, DAC, which results in MPAI under conditions of continuous exposure to an airborne radionuclide. The use of a derived limit for concentration in water should be discontinued because water is only one source of intake by ingestion. The ingestion of radionuclides should be controlled by use of the appropriate values of MPAI. The derivation of MPAI and DAC, their use in practice and suggestions for a review of the philosophy at present adopted for planning exposure to radioactive materials are discussed. (auth)

26184 (EUR-5397e, pp 63-72) HOW WE SHALL COMBINE THE DOSES TO DIFFERENT BODY ORGANS? Problems and Ideas. Jacobi, W. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). 1975.

From 2nd international conference on radiation protection–philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

One possible concept for the combination of organ doses is discussed. This concept is based on the assumption that at low doses the total radiation detriment to the exposed person is given by the sum of radiation detriments to the single organs. Taking into account a linear dose-risk relationship the sum of weighted organ doses leads to the definition of an Effective Dose. The applicability and consequences of this Effective Dose–concept are discussed especially with regard to the assessment of the maximum permissible intake of radionuclides into the human body and the combination of external and internal exposure. Our present system of basic radiation protection standards defines only the maximum permissible dose for irradiation of single organs and for uniform irradiation of the whole body. In practice however, irradiation leads more frequently to an inhomogeneous dose distribution within the human body and to an exposure of several organs or tissues. The development of a reasonable concept for the combination of organ doses is therefore one of the fundamental problems of radiation protection. (auth)

26185 (EUR-5397e, pp 95-102) SUGGESTED RADIATION SURVEY PARAMETER. Harvey, J. R. (Central Electricity Generating Board, Berkeley, Eng.). 1975.

From 2nd international conference on radiation protection–philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The present system for monitoring radiation environments is both cumbersome and confusing. Gamma and X-ray fields are surveyed in roentgens neutron fields in rems and beta and electron fields in rads in air or tissue. In practice, all these units are referred to as R and assumed to coincide roughly with the quantity appropriate to protection against external radiation, which is the

peak dose equivalent in the body, specified in rems. There have been suggestions for improvements in the present system and the ICRU have recently introduced a radiation survey parameter which has not however received universal acceptance. In this paper it is suggested that a radically different approach to the specification of a radiation field might have some advantages and lead to a clarification of the role of survey instruments. (auth)

26186 (EUR-5397e, pp 103-112) INTERPRETATION OF RADIATION SURVEYS ON OPERATIONAL POWER SYSTEMS. Lakey, J. R. A.; Spiers, E. W. (Royal Naval Coll., Greenwich, Eng.). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The design of the radiological safety systems of a nuclear power plant involves the calculation of operational radiation exposure. The usual philosophy of designers is to adjust the calculated exposure rate to a value which, for example, might be below specified limits at a physical surface and thus ensure that individual operators have no opportunity to approach higher radiation fields. The design predictions are subsequently tested by means of radiation measurements and this survey data is often used as a basis for future modification of the plant. This paper reviews the interpretation of the measurements made in the survey of shielded radiation sources and describes experimental work on "bench mark" rigs which permit comparative calculations and measurements to be made under controlled conditions. The results of these measurements are discussed and suggestions are made for possible future developments in shield survey procedures. (auth)

26187 (EUR-5397e, pp 114-121) PROBLEMS POSED BY THE PRACTICAL APPLICATION OF EUROPEAN RADIOPROTECTION STANDARDS. Recht, P. (EURATOM, Luxembourg). 1975. (In French).

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The following topics are discussed: maximum permissible dose; identification of exposed workers; classification of work places; medical supervision of populations; and genetic dose limits in the general population. Using the ICRP recommendations as a guide and taking into account 15 yrs of experience of application of early standards, the Commission presents revised standards having advantages of efficiency and precision. These standards are subject to modifications concerning practical organization of radioprotection, but they increase the effectiveness of supervision of personnel exposed to radiation. (HLW)

26188 (EUR-5397e, pp 122-128) ADMINISTRATIVE CRITERIA FOR ENSURING COMPLIANCE WITH ICRP RECOMMENDED ORGAN DOSES. Evans, H. D. (Imperial Coll., London). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Numerical limits of external dose are recommended by ICRP and laid down in UK legislation and it is relatively easy, using personal dosemeters, to demonstrate that a worker is keeping within those limits. The uncertainty of estimating organ dose resulting from internal contamination makes demonstrable compliance with fixed values more than a little difficult, and although ICRP recommends approximate numerical dose limits, these have not been carried over into legislation for obvious reasons. It is, however, no less important that workers' internal doses should be kept within these limits and this paper discusses simple administrative criteria for incorporation in legislation which will ensure, with a high degree of confidence, that specified organ doses are not exceeded. British legislation affecting persons working with sources of ionizing radiation divides workers into two broad groups, in line with the recommendations of the International Commission on Radiological Protection (1966). The only substantially quantitative division is on the basis of external dose and although legislation concerning the use of unsealed radioactive substances defines the type of work which falls into the upper, more restrictive category, the definition is not sufficiently precise for general application without qualification. There is, therefore, a growing need for a new appraisal of the problem and for producing more definitive criteria for this class of work. (auth)

26189 (EUR-5397e, pp 129-132) INSULT AND INJURY: OBJECTIVES OF THE MANAGEMENT OF INDIVIDUALS EXPOSED IN EXCESS OF THE RECOMMENDED LIMITS. McLean, A. S. (National Radiological Protection Board, Harwell, Eng.). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The assessment of radiation doses is discussed with regard to external and internal radiation. When over-exposure is suspected, it is necessary to make an estimate of the dose to the body or to organs and tissues. It is pointed out that any administrative action, such as removal from radiation work can be arbitrary if it is based on assessments of doses or dose commitments, especially when these are only a little in excess of the limits. Recommendations of the ICRP are that the situation should be reviewed by a competent medical authority and that the worker might be allowed to continue routine work if there were no medical objection. Administrative options after over-exposure are discussed. (HLW)

26190 (EUR-5397e, pp 133-142) OFFICIAL ACTION FOLLOWING EXCESSIVE RADIATION DOSES. Atherton, N. J. (H. M. Factory Inspectorate, London). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

This paper describes the action taken by HM Factory Inspectorate following receipt of a notification that a person working under the Factories Act has received a radiation dose greater than the maximum permitted for a calendar quarter, a calendar year, or the person's cumulative total. Excessive radiation doses usually come to light from results of personnel monitoring; sometimes an untoward incident indicates that an excessive dose may have been received. In either case, an investigation must be made, and notification sent to an employment medical adviser or appointed doctor, and also to the District Inspector of Factories. Under U. K. legislation relating to factories, the results of personnel monitoring must be entered on personal dose records; the entries so made are taken as representative of the doses actually received, unless a special entry has been approved by the Chief Inspector of Factories. He may do this if he has reason to believe that the radiation dose actually received by the person is significantly different from the dose indicated by personnel monitoring. The criteria applied in such cases are outlined. When a worker's total radiation dose is greater than the maximum permitted, he should not be further employed on radiation work for a period depending on the magnitude of the total dose. Examples of excessive doses and the minimum waiting periods are given. (auth)

26191 (EUR-5397e, pp 150-163) LOG-NORMAL STATISTICS APPLIED TO THE PLANNING, COLLECTION, AND ANALYSIS OF PREOPERATIONAL ENVIRONMENTAL SURVEILLANCE DATA. Waite, D. A.; Denham, D. H. (Battelle Pacific Northwest Labs., Richland, WA). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Basic principles and advantages of using log-normal techniques to plan, collect and analyze preoperational environmental data have been discussed. The utility and ease of the exhibited log-normal analysis techniques when coupled with the use of existing environmental background data, nuclear facility characteristics and pathways analyses seems to warrant its expanded use in the design of environmental surveillance systems. Greater understanding of and ability to physically interpret distribution shapes will add even more analytic practicability to the techniques. (auth)

26192 (EUR-5397e, pp 164-173) IN VIVO MONITORING OF RADIATION WORKERS WITH PORTABLE EQUIPMENT: THE RATIONALE, THE METHODS, AND THE IMPLICATIONS. Pomroy, C.; Gordon, J.; Letourneau, E. (Radiation Protection Bureau, Ottawa). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Whole body counting is well established as a useful technique in the field of radiation protection. Unfortunately the conventional

whole body counter is a very expensive piece of equipment, found only in large centers, and is an inherently stationary device. The Radiation Protection Bureau in Canada has undertaken a program to expand the use of whole body counting in its radiation protection programs by the development of portable apparatus. This is particularly appropriate in Canada due to the small number of conventional whole body counters and the large distances between population centers. The specific aspects of measurement undertaken by the Bureau fall into two main categories: measurement of the body burdens of medium to high energy gamma emitters, in such subjects as nuclear medicine technicians and other laboratory workers; measurement of particular organ burdens of low energy gamma emitters, such as lung burdens of uranium in nuclear fuel production workers. (auth)

26193 (EUR-5397e, pp 174-182) CHROMOSOME ABERRATION ANALYSIS IN RADIOLOGICAL PROTECTION. Purrott, R. J. (National Radiological Protection Board, Harwell, Eng.). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Chromosome aberrations are uncommon in the lymphocytes of the general population but their frequency increases as a function of the dose following exposure to ionizing radiation. Techniques of chromosome aberration analysis have therefore been developed at NRPB Harwell which can be used to estimate routinely the dose received by individuals thought to have been over-exposed. (auth)

26194 (EUR-5397e, pp 183-185) RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE PHILOSOPHY AND IMPLEMENTATION FOR US NUCLEAR POWER STATIONS. Porter, S. W. Jr. (Porter-Gertz Consultants Inc., Ardmore, PA). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The criteria and methods for implementing a state-of-the-art radiological environmental monitoring program are discussed in light of USAEC, USEPA, and IAEA guides. The AEC draft Guide for the Content of Nuclear Power Plant (Radiological) Environmental Technical Specifications is reviewed in detail. (auth)

26195 (EUR-5397e, pp 188-200) RADIATION EXPOSURE OF THE PUBLIC: THE CURRENT LEVELS IN THE UNITED KINGDOM. Webb, G. A. M. (National Radiological Protection Board, Harwell, Eng.). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The relative contributions to overall U. K. collective gonad dose and genetically significant dose are summarized in Table 8. It is obvious that medical exposure is the largest man-made contributor to G. S. D. and it is in this area that reductions in G. S. D. could be most readily achieved. Fallout, even at the reduced levels of current years is still the next largest contributor but is not susceptible to control. In some ways the very small dose attributable to waste discharges from the nuclear power industry is misleading as a proportion of the occupational dose figure is also connected with this industry. Miscellaneous sources, although generally regarded as rather insignificant compared with nuclear power waste disposals may be an order of magnitude more important at present in their overall genetic effect on the population. (auth)

26196 (EUR-5397e, pp 207-214) EXPERIENCE GAINED IN APPLYING THE CRITICAL GROUP CONCEPT TO THE ASSESSMENT OF PUBLIC RADIATION EXPOSURE IN CONTROL OF LIQUID RADIOACTIVE WASTE DISPOSAL. Preston, A.; Mitchell, N. T.; Jefferies, D. F. (Ministry of Agriculture, Fisheries and Food, Lowestoft, Eng.). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The principal objectives of United Kingdom policy for the control of radioactive waste disposal are to limit human radiation exposure such that: exposure of individual members of the public is within the ICRP dose limits; and the collective dose to the population of the country does not, on the average, exceed 1 rem per person in 30 years. It is a practical necessity, in setting controls to reach such objectives for liquid radioactive wastes, to consider each site individually. Furthermore, in almost all cases individual exposure is much more significant than the contribution to population exposure. The population exposure is of the order of 10^{-3}% of the limit specified; maximum individual exposure values are a few percent. This makes the assessment of individual exposure of major importance. The model used in assessing exposure is based on critical path techniques and utilizes data obtained from surveys of the exposed population. In the early years control was based on the exceptional individual identified from a representative sample of the exposed population. Because of the innate variability of the metabolic factors which also determine the dose received, this involved an intrinsic assumption which may not always be valid. The concept of a critical group, as opposed to critical individuals, was developed somewhat later by ICRP (ICRP (1966)) to take account of these and other anomalies. This paper is an attempt to review experience in the use of this concept in the UK. (auth)

26197 (EUR-5397e, pp 215-232) RADIATION PROTECTION STANDARDS: COMPLIANCE BY MEASUREMENTS OF MODELS? Rowe, W. D. (Environmental Protection Agency, Washington, DC). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Under its mandate, EPA is responsible for the protection of individuals and the population from exposure to all kinds of ionizing radiation. Systematic application of the linear nonthreshold assumption to radiation protection from the total radiation exposure leads to the Agency's goal of minimizing health risk from radiation exposure on a risk-cost-benefit basis. The information obtained from monitoring represents the current status of risk. This is used as input to the risk-cost-benefit analyses that are the foundations of the environmental standards. Monitoring also provides EPA with program management information used to determine measures of progress, degree of compliance with standards, and for other management needs. Monitoring information is required for all kinds of radiation exposures; consequently, the conventional approach to monitoring would require a national program of ambient and local source radiation exposure measurements to individuals and the population. The conventional approach, which utilizes measurement only, leads to the need to measure everything, everywhere, all of the time, which becomes exceedingly expensive. The EPA approach is to use measured source releases, establish computer models, compute individual and population doses, and validate the computations by measurements that are made at selected locations and times. This approach, which requires extensive use of models to predict dose (and, hence, risk) and minimal environmental measurements, is expected to be more cost-effective. (auth)

26198 (EUR-5397e, pp 234-245) SAFETY AND SITING OF CEGB REACTORS. Dale, G. C. (Central Electricity Generating Board, London). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The following topics are discussed: initial siting controls; radioactive releases from nuclear power stations; numerical siting criteria; emergency reference levels; and possible future developments. The population characteristics when considered in association with coastal or estuarial sites almost invariably led to locations which are highly prized for their amenity value arising from their isolation and unspoiled nature. The CEGB has a statutory obligation to have regard to the preservation of amenity in carrying out its duties of providing an efficient, coordinated and economical supply of electricity. The siting criteria detailed above and the fact that in England and Wales over 40% of land and 30% of coastline are protected by legislation made it inevitable that the first nuclear power stations would cause a conflict of interests. With the background of population criteria and amenity interests the site investigations were directed towards those parts of the country nearest to the heavy electricity demands and distant from the sources of the lowest cost coals. (HLW)

26199 (EUR-5397e, pp 246-255) STANDARDS FOR CONTROL OF RADIATION DOSES TO THE PUBLIC AFTER ACCIDENTAL ESCAPE OF RADIOACTIVE MATERIAL. Bryant, P. M. (National Radiological Protection Board, Harwell, Eng.). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

During the period 1959 to 1961 the UK Medical Research Council published recommendations on standards relevant to the consideration of counter measures to control public radiation exposure which might result from accidental escape of radioactive material from nuclear establishments. Revised recommendations have resulted from a recent review carried out under the aegis of the Council. These recommendations include some revision of values of the basic standard, i.e., the emergency reference level (ERL) of dose, and substantial revision of certain derived ERLs in environmental materials. These latter changes result from improved knowledge of radionuclide metabolism and dosimetry in humans and of food chain mechanisms. Of particular interest is the change of critical organ for radiostrontium contamination from the site of maximum concentration in mineral bone to the bone marrow. The overall result is much less restrictive values for derived ERLs for radiostrontium in environmental materials. (auth)

26200 (EUR-5397e, pp 275-284) NUCLEAR ACCIDENT DOSIMETRY: UK PHILOSOPHY. Delafield, H. J.; Gibson, J. A. B. (Atomic Energy Research Establishment, Harwell, Eng.). 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

The general philosophy underlying our approach to nuclear accident dosimetry has been presented, and then illustrated by a description of the dosimetry system adopted at Harwell and other nuclear establishments. Experimental and supporting theoretical studies have shown that satisfactory dose estimates can be made with the U.K.A.E.A. Personnel Criticality Dosimeter for a wide variety of neutron spectra providing appropriate methods of interpretation are used. For moderated spectra having a significant proportion of intermediate energy neutrons it has been shown necessary to incorporate body sodium-24 measurements to obtain a satisfactory dose estimate. This implies that four personnel criticality dosimeters must be worn on a belt to enable corrections to be made to the observed sodium activity. The installed neptunium dosimeter with its lower effective threshold energy is also of particular value for the measurement of moderated neutron spectra. In a practical case it would be advisable to make dose estimates by as many ways as possible. The relative weight to be attached to the different dose estimates would have to be judged against the expected performance of the method used for the type of neutron spectrum encountered. Moreover the accuracy of the detector measurements would need to be taken into consideration. For example, too great an importance should not be attached to sodium-24 measurements if large corrections have to be made to the observed value. (auth)

26201 (GSF-K-75, pp v) RADIATION PROTECTION IN MEGAVOLT THERAPY. Wiederoee, R. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Following brief data on the radiation protection standards of today and the aspects which determined the requirements, short data on neutrons are given. The fast neutrons occurring with betatron radiation are particularly dealt with here. Data on the radiation protection of the patient then follow where the relative volume dose (i.e., the relative radiation exposure) as well as the radiation given off besides the signal field (secondary radiation) of the betatron are dealt with. The protective measures to be met in order to keep the secondary radiation within permissible limits are discussed, and finally data on plants equipped with 35 MeV betatrons and linear accelerators are given. (DE)

26202 (GSF-K-75, pp v) BIOLOGICAL EFFECTS. Trott, K. R. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Following an introduction into the field of cellular radiation effect considering the most important experimental results, the biological significance of the colony formation ability is brought out. The inactivation concept of stem cells does not only prove to be good, according to the present results, in the interpretation of the pathogenesis of acute radiation effects on moult tissue, it also enables chronic radiation injuries to be interpreted through changes in the fibrous part of the organs. Radiation therapy of tumors can also be explained to a large extent by the radiation effect on the unlimited reproductiveness of tumor cells. The more or less similar dose effect curves for healthy and tumor tissue in practice lead to intermittent irradiation. The dependence of the intermittent doses and intervals on factors such as Elkind recovery, synchronization, redistribution, reoxygenation, repopulation and regeneration are reviewed. (DE)

26203 (GSF-K-75, pp v) PATIENT RADIATION PROTECTION IN MEGAVOLT THERAPY. Scherer, E. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

A survey is given on the practically important organs and organ systems whose radiation sensitivity and type of reaction are of significance regarding irradiation planning. (DE)

26204 (HEDL-SA-9045) DOSE RATE ANALYSES FOR FAST REACTOR FUEL MANUFACTURERS. Smith, R. C.; Strode, J. N.; Brackenbush, L. W.; Faust, L. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1976. 13p. (CONF-750607-42). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

An early appraisal of the radiation exposure situation in the fabrication of plutonium enriched mixed-oxide fuels for fast reactors is presented. Radiation data are presented on fuel process operations measured under actual operating conditions using plutonium containing up to 19 wt percent ^{240}Pu. (LK)

26205 (SAAS-185) REPORT OF THE NATIONAL COUNCIL FOR ATOMIC SAFETY AND RADIATION PROTECTION OF THE GERMAN DEMOCRATIC REPUBLIC. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Sep 1975. 20p. (In German). Dep. NTIS (US Sales Only) $4.00.

Separate abstracts were prepared on two sections of this report. (CH)

For abstracts of individual sections see: 26206 and 26207.

26206 (SAAS-185, pp 3-13) CHOICE OF MEASURING SITE IN EXTERNAL PERSONNEL ROUTINE DOSIMETRY. Rothe, W. Sep 1975. (In German).

In report of the National Council for Atomic Safety and Radiation Protection of the German Democratic Republic.

In personnel routine dosimetry the choice of a suitable measuring site is of great importance because there may be great differences between the measured doses and the equivalent doses of the whole body and of single organs, respectively. In the literature there are different points of view with regard to the measuring site, particularly if diagnostic x-radiation is used and the body is partly covered with protective clothing. Likewise in most cases the conclusions regarding the most suitable measuring site drawn from measurements of dose distributions on the body surface are not in agreement. (auth)

26207 (SAAS-185, pp 15-20) COMMENTS ON BUILDING AND EQUIPMENT OF RADIOACTIVE ANIMAL LABORATORIES. Wolf, G.; Gensicke, F.; Nitschke, H. W. Sep 1975. (In German).

In report of the National Council for Atomic Safety and Radiation Protection of the German Democratic Republic.

The report deals with the requirements to be met by building and equipment of radioactive animal laboratories, as seen from the veterinary medicine and radiation protection points of view. Also guidance concerning the rebuilding of already existing animal rooms into radioactive animal laboratories is given. (auth)

26208 (SAAS-187) FIRST ADVANCED TRAINING COURSE ON NUCLEAR SAFETY AND RADIATION PROTECTION HELD IN OBERSCHLEMA/ERZGEBIRGE FROM 5 TO 8 MAY 1975. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Oct 1975. 11p. (In German). Dep. NTIS (US Sales Only) $3.50.

This course organized by the Board of Nuclear Safety and Radiation Protection of the German Democratic Republic dealt with the determination of internal radiation exposure. Sixteen papers were presented, the abstracts of which have been compiles. (auth)

26209 (SAAS-188) RELATIONS BETWEEN RADIATION RISKS AND RADIATION PROTECTION MEASURING TECHNIQUES. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1975. 20p. (In German). Dep. NTIS (US Sales Only) $3.50.

Risk of damage and exposure risk are considered as components of the radiation risk. The influence of the exposure risk on type and extent of radiation protection measurements is discussed with regard to different measuring tasks. Based upon measured results concerning the frequency of certain external and internal

occupational exposures in CDR, it has been shown that only a small fraction of the monitored persons are subjected to a high exposure risk. As a consequence the following recommendations are presented: occupationally exposed persons with small exposure risk should be monitored using only a long-term dosimeter (such as a thermoluminescende dosimeter) and in the case of internal exposure, surface and air contamination should be controlled so strictly that routine measurements of internal contamination need not be performed. (auth)

26210 AUTOANTITELA OBLUCHENNOGO ORGANIZMA. (Autoantibodies of Irradiated Organisms). Klemparskoi, N. N. (ed.). Moscow; Atomizdat (1972). 280p.

Literature data and the results of studies by the authors of the 19 papers on the characteristics of the dynamics of the formation of autoantibodies in irradiated animals and people exposed to x radiation are generalized. Analyses are made of material on the isolation and purification of preparations of autoantibodies from the blood serum and tissues of the internal organs of animals. The results of studies on the use of these preparations for therapy in radiation sickness are discussed. The significance of the autoimmunological reaction in the female organism for the appearance of pathology of the fetus and progeny is discussed. In the second part of the book materials are described on the determination of cells forming autoantibodies in the blood of humans and in the blood and organs of animals. Their increase under the effects of ionizing radiation is also considered. Data are reported on the passive transfer of the autoimmunological reaction from an irradiated recipient. The book contains not only new material on theoretical questions of radiobiology but also practical recommendations on its usefulness. (tr-auth)

26211 UNIFORM POSITIONING IN ROUTINE ABDOMINAL X-RAY DIAGNOSIS. Gileadi, M. (Puerto Rico Nuclear Center, Mayaguez). Health Phys.; 29: No. 6, 883-885(Dec 1975).

From 19th annual meeting of the Health Physics Society; Houston, TX, USA (Jul 1974).

The factors which can contribute to the wide variation in reported gonadal dose values, incurred by patients in what is stated by authors as being the same routine abdominal diagnostic x-ray examination, are listed. Considering the enumerated factors, methods whereby better uniformity could be achieved including, in particular, uniformity on positioning of the patient (for pelvis, lumbar spine, and femur examinations) but also more accurate definition of each routine and more uniform practice (number of films used etc), are discussed. It is shown that by uniform positioning significant steps can be made in eliminating unreasonable differences, thus making reported gonadal dose values for a given procedure more meaningful. (UK)

26212 POPULATION EXPOSURE FROM HIGH-ENERGY ACCELERATORS. Stephens, L. D.; Thomas, R. H.; Thomas, S. B. (Univ. of California, Berkeley). Health Phys.; 29: No. 6, 853-860(Dec 1975).

There is increasing interest in estimating the magnitudes of population exposure due to the operation of nuclear facilities. This paper discusses the population exposures that might result from high energy accelerators. External whole body radiation is the dominant type of radiation exposure, while exposure resulting from the leakage of radionuclides into the atmosphere or ground water is negligible. At large distances from operating accelerators, neutrons are the predominant form of radiation. The transport of high-energy neutrons through the atmosphere is not well understood at distances greater than about 1000 m from the radiation source. Consequently, estimates of population exposure out to distances of 80 km from high energy accelerators may be quite inaccurate. It is extremely important that health physicists and administrators be aware of the limitations of estimates of population exposure. A model is described which facilitates the estimation of population exposure due to accelerators and its limitations are discussed. Suggestions are made for experimental investigations which would improve the model. (auth)

26213 RAPID ESTIMATION OF THE RADIATION DOSE TO PATIENTS FROM RADIONUCLIDIC IMPURITIES IN ELUATES FROM GENERATORS. Colombetti, L. G. (Loyola Univ., Maywood, IL). Int. J. Appl. Radiat. Isot.; 26: No. 11, 667-670(Nov 1975).

A method is presented for the estimation of the contribution to patient radiation dose from the radioactive impurities in eluates from generators. The proposed equations involve the dose equivalent per unit of activity, the fraction of the radionuclidic impurity contained in the principal radionuclidic activity and the time lag between milking and administration of the radiopharmaceutical to the patient. An example of the values of dose equivalents for some impurities occurring in eluates of ^{99m}Tc is presented. (auth)

26214 AUGMENTATION OF CYTOTOXIC DRUG ACTION AND X IRRADIATION BY ANTIBODIES. Rubens, R. D.; Vaughan-Smith, S.; Dulbecco, R. (Imperial Cancer Research Fund Labs., London). Br. J. Cancer; 32: No. 3, 352-354(Sep 1975).

The effect of an antiserum containing antibodies against cell surface components of PyBHK cells on the action of certain anticancer agents has been studied using a colony formation inhibition assay. The effects of x-rays, chlorambucil, CCNU and possibly ICRF 159 were augmented by the antiserum whereas methotrexate and vinblastine were not. (auth)

26215 LYMPHOCYTES OF THE BLOOD DURING IRRADIATION UNDER CONDITIONS OF HYPERBARIC OXYGENATION. Sokolova, I. I.; Volkova, M. A.; Daryalova, S. L. (Scientific-Research Inst. of Oncology, Moscow). Med. Radiol.; 20: No. 12, 25-28(1975). (In Russian)

When studying functional-morphological condition of lymphocytes in 52 patients suffering from cancer of the lung, sarcomas of soft tissues, and tumors of the head and neck, before and after the end of the radiation therapy course under the conditions of hyperbaric oxygenation, the authors determined definite correlation between the condition of lymphocytes and tolerance of irradiation under the mentioned conditions by the patients. The absence of general reactions to irradiation is more often accompanied by the change of the cell diameter. With the presence of such reactions the increase of the diameter is combined with the increase of the number of phosphotasoactive forms among lymphocytes. (auth)

26216 DYNAMICS OF CHROMOSOME ABERRATIONS IN LYMPHOCYTES OF PERIPHERAL BLOOD AFTER RADIATION THERAPY. Guzeev, G. G.; Sevankaev, A. V.; Baisogolov, G. D.; Danchik, V. N. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 20: No. 12, 17-21(1975). (In Russian)

The authors studied chromosome aberrations in the lymphocytes of the peripheral blood in patients suffering from urinary bladder cancer immediately after the completion of radiation therapy course, and also 3, 6, 12, 24, months after it. The frequency of chromosome aberrations (on 100 cells) comprised in them correspondingly 49.7; 31.9; 27.0; 20.6 and 11.2. On the basis of some types of chromosome aberrations the authors voiced a supposition about a partial restoration of a proliferative capability of the lymphoid tissue cells of the irradiated parts of the body. (auth)

26217 ANGIOGRAPHY AND LYMPHOGRAPHY IN THE STUDY OF THE STATE OF THE HEMOPOIETIC AND LYMPHATIC SYSTEMS DURING LOCAL IRRADIATION. Mannanov, I. S.; Tsyb, A. F.; Nestaiko, O. V. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 20: No. 12, 58-63 (1975). (In Russian)

A review is given of the data published in the last 15 years on the practical and clinical uses of angiography and lymphography to follow the condition of the hompoietic and lymphatic systems during localized radiation therapy. (JSR)

26218 PATHOGENETIC SUBSTANTIATION OF EARLY THERAPY OF ACUTE RADIATION SICKNESS IN EXPERIMENT. Dzharakyan, T. K. (Air Force Medical Academy, Leningrad). Med. Radiol.; 20: No. 12, 52-57(1975). (In Russian)

Processes lying at the basis of developing aplasia of the bone marrow after lethal irradiation of animals are considered in the article. Literature data testifying to their early origin (during the first hours and days) after irradiation are given and lead to the radiation block of proliferation, mass interphasic death of cells. Due to this devastation of the bone marrow the degree of which determines the severity of the course and outcome of the disease is noted by the 3 to 5th day. The author submits literature data which show the possibility of using some pharmacological substances to weaken the degree of proliferation inhibition and to decrease the lot of the picnotically changed cells in the bone marrow and lymphoid organs. Such a therapeutic intervention during the first hours after irradiation may substantially weaken devastation of the bone marrow by providing a wider springboard for restoration of hemopoiesis and thereby decrease the severity of the affection and increase the number of favorable outcomes. (auth)

26219 METHOD OF CALCULATION OF ABSORBED DOSES IN RADIOISOTOPE INVESTIGATION OF THE THYROID GLAND. Kalachev, A. I. Med. Radiol.; 20: No. 12, 42-45(1975). (In Russian)

The article presents a method of determining absorbed doses on the thyroid gland. The effective period of half elimination was determined by radiometry method of the whole body. With the help of this method the authors observed 26 patients with thyrotoxicosis in mild form; 21 patients with thyrotoxicosis of

moderate severity and 13 patients with severe thyrotoxicosis. On the basis of obtained data the dependence of T_{eff} upon the assimilation percentage ^{131}I of the thyroid gland (assimilation percentage – in 24 h) was deduced. The weight of the thyroid gland was obtained by the surface of scannograms. The simplified formula for the assessment of absorbed dose in the thyroid gland was proposed. Data on patients and doses obtained by them during treatment are presented. (auth)

26220 CORRELATION BETWEEN DOSE AND INDUCED CHROMOSOMAL ABERRATIONS BY ROENTGEN AND PROTON RADIATION IN HUMAN PERIPHERAL BLOOD LYMPHOCYTES. Todorov, S. L.; Grigoriev, Yu. G.; Rizov, N. I.; Ivanov, B. A.; Maljutina, T. S.; Milev, M. S. Letopisi Khig.-Epidemiol. Sluzhba; 8: No. 42, 156-164(1974). (In Russian).

On the basis of experimental data correlation values were developed on the yield of chromosomal aberrations following 180 Kv x-radiation and 50 MeV proton radiation; data were also adduced on the relative biological effectiveness of protons based on the yield of dicentrics in human lymphocytes. In x-ray-exposed human lymphocytes the most commonly observed structural chromosomal aberrations are the dicentrics, the interstitial deletions, chromosomal fragments, and rings. With increasing dose grows the yield of all kinds of structural chromosomal abberations, except the chromatid fragments. Proportionally to the dose increases the number of one-stroke and two-stroke breaks, as well as the incidence of aberrant cells. After exposure of human lymphocytes to 50 MeV protons, the most frequently encountered two-stroke abberrations are the dicentrics, interstitial deletions, and rings; among the one-stroke aberrations most common are the chromatid fragments. Here also the dose increase leads to a clear-cut increase in the number of chromosomal aberrations. The relative biological effectiveness (RBE) of 50 Mev protons by the yield of dicentrics was also studied. Its value for the 100 to 500 rad span is equal to 0.88. This RBE quotient for 50 MeV protons does not differ from the RBE for protons of higher energies and is in keeping with the thus far obtained data on other biological models. (Abstr. Bulg. Sci. Med. Lit.)

26221 SPACING NOMOGRAPH FOR INTERSTITIAL IMPLANTS OF ^{125}I SEEDS. Anderson, L.L. (Department of Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, New York 10021). Med. Phys. 3: No. 1, 48-51 (Jan 1976).

Permanent implants of ^{125}I seeds at Memorial Sloan-Kettering Cancer Center are performed by the method of "dimension averaging" to determine the total activity to be implanted; that is, the activity (in mCi) is taken to be five times the average dimension (in cm) of the target region. A nomograph has recently been developed to permit a rapid calculation of the seed spacing required for a uniform distribution of the number of seeds specified by dimension averaging. The number of seeds is also given by the nomograph. The spacing calculation performed with the nomograph, since it involves the two-thirds power of average dimension and the one-third power of seed strength, is well beyond the reach of mental arithmetic. Elongation and shape corrections are included. The nomograph spacing result is valid for an equipartition of measured volume among seeds but must be increased by an easily determined factor if peripheral seeds are considered to define the surface of the target region. (auth)

26222 COMPARISON OF SPLIT-COURSE RADIATION THERAPY AND CONTINUOUS RADIATION THERAPY FOR UNRESECTABLE BRONCHOGENIC CARCINOMA: 5 YEAR RESULTS. Lee, R. E.; Carr, D. T.; Childs, D. S. Jr. (Mayo Clinic and Mayo Foundation, Rochester, MI). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 126: No. 1, 116-122(Jan 1976).

From 57th annual meeting of the American Radium Society; Isla Verde, Puerto Rico (4 May 1975).

One hundred and eighty-eight patients with inoperable or unresectable bronchogenic carcinoma were stratified by cell type, TNM staging, and prior surgery and then randomized into two treatment groups: continuous radiation therapy and split-course radiation therapy. There was no difference in clinical or objective improvement in the two groups. Survival rates for cases of squamous cell carcinoma, small cell carcinoma, and adenocarcinoma were the same after both regimens of therapy. Split-course therapy resulted in a significantly better survival rate in cases of large cell carcinoma but the number of cases was small. We doubt that the difference is clinically significant. Objective roentgenographic response was accompanied by improved survival in squamous cell carcinoma, but not in the other three cell types. Split-course radiation therapy is superior to continuous radiation therapy because it is better tolerated by the patient and because re-examination of the patient prior to the second half of split-course therapy permits the detection of new metastatic disease that has become manifest during the rest period and spares the patient the futile second half of radiation therapy. (auth)

26223 RBE STUDIES IN RELATION TO NEUTRON THERAPY. Hornsey, S.; Field, S. B. (Hammersmith Hospital, London). Radiaz. Alta Energ.; 14: No. 2, 49-56(Apr 1975).

The wide variation in RBE values obtained at low doses for tumors emphasizes the fact that we do not know which are the important cell and tissue parameters which determine the RBE response. With normal tissues we may make observations on animals and experimentally derive the equivalent RBE relationship with dose per fraction. These RBE values can then be used to convert photon dose to neutron dose in preliminary clinical work. The clinical experience at Hammersmith on patients treated with neutrons suggests these values have given a good guide-line. With tumors the situation is more difficult. The observations so far suggest that at low doses, RBE is unrelated to tumour type, degree of differentiation, growth rate or even the proportion of hypoxic cells. As the response of one mammary sarcoma in rats is different from another similar one, it is clear that we cannot extrapolate even from one mammary rat tumor to another mammary rat tumor let alone extrapolate to human tumors. There is need for much fundamental work from the radiobiologist to find some measurable parameter in cells which will help us predict the response of tumor cells both to neutrons and photons, so that we may in the future assign patients to neutron or photon treatment on the expected relative response of the tumor and the limiting normal tissue in the particular treatment. (auth)

26224 USE OF LITHIUM AS AN ADJUNCT TO RADIOIODINE THERAPY OF THYROID CARCINOMA. Gershengorn, M. C.; Izumi, M.; Robbins, J. (National Inst. of Health, Bethesda, MD). J. Clin. Endocrinol. Metab.; 42: No. 1, 105-111(Jan 1976).

The effect of lithium on iodine kinetics after oral ^{131}I-iodide was studied in an athyreotic patient with follicular thyroid carcinoma. Lithium decreased the disappearance rate of ^{131}I from the whole body and from a tumor mass in the patient's thigh from control values of 0.126/day and 0.122/day to 0.090/day and 0.049/day, respectively, while having only a minimal effect on the rate of ^{131}I disappearance from blood. The increased tumor ^{131}I retention would be expected to increase the therapeutic:toxic ratio of ^{131}I. However, a subsequent therapeutic dose of ^{131}I-iodide given with lithium was accompanied by an unanticipated increase in blood ^{131}I and, therefore, in whole body radiation, resulting in significant bone marrow depression. Although lithium may be a useful adjunct in ^{131}I therapy of functional thyroid carcinoma, it must be used cautiously in future studies. (auth)

26225 THE CONCEPT OF THE EFFECTIVE DOSE. A Proposal for the Combination of Organ Doses. Jacobi, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). Radiat. Environ. Biophys.; 12: No. 2, 101-109(Jul 1975).

From international symposium on radiation protection, philosophy and implementation; Aviemore, UK (3 Jun 1974). 2 tabs.; 6 refs.

Irradiation of the human body by external or internal sources leads mostly to a simultaneous exposure of several organs. However, so far no clear and consistent recommendations for the combination of organ doses and the assessment of an exposure limit under such irradiation conditions are available. Following a proposal described in ICRP-publication 14 one possible concept for the combination of organ doses is discussed in this paper. This concept is based on the assumption that at low doses the total radiation detriment to the exposed person is given by the sum of radiation detriments to the single organs. Taking into account a linear dose-risk relationship, the sum of weighted organ doses leads to the definition of an Effective Dose. The applicability and consequences of this Effective Dose Concept are discussed especially with regard to the assessment of the maximum permissible intake of radionuclides into the human body and the combination of external and internal exposure. (DE)

26226 ELECTRON THERAPY USING WEDGE FILTERS. Pt. 1. Experimental Research Using Wedge Filters Made of Polystyrol. Kuttig, H.; Ziegler, F. (Heidelberg Univ. (F. R. Germany). Strahlenklinik). Strahlentherapie; 150: No. 4, 383-388(Oct 1975). (In German)

4 figs.; 1 tab.; 17 refs.

Based on dose measurements at the phantom, the dose distributions obtained during electron therapy by the use of wedge filters made of polystyrol are reported. Energy doses from 15 to 42 MeV were applied; angles of wedges amounted to 10°, 30°, 45°, and 60°. Only by wedge-angles larger than 45°, it was possible to bring about significant changes in the dose distribution. The results obtained are presented as diagrams. The influence exerted by the wedge-angle and by electron energy upon the inclination of the 50%-isodose to the axis of the useful beam is shown by tables. (DE)

26227 POSSIBILITIES OF DOSE DISTRIBUTION IN AFTER-LOADING TECHNIQUE. Walstam, R. (Radiofysiska Institutionen, Stockholm (Sweden)). Strahlentherapie; 150: No. 3, 251-257(Sep 1975). (In German)

3 figs.; 20 refs.

Remote (controlled) afterloading installations offer the possibility to improve the dose distributions of the different applicators, since this apparatus permits the employment of artificial radionuclides with a high specific activity and with low energy of γ rays. It is therefore possible to incorporate effective shielding into the applicators. The possible individual fitting of the dose distribution, however, demands considerable clinical effort, as the extension of the tumor in question has to be ascertained with sufficient accuracy. Otherwise, underdosage to tumor cells may happen within the shielded area. Most afterloading techniques are using stiff applicators and geometrical fixation within patients; configuration and position of the radiation sources in the patient therefore remain unchanged during the whole irradiation. Thus, it becomes possible to adapt additional external irradiation more exactly than before to the intracavitary dose distribution. (DE)

26228 SAVING EXPOSURE IN CHILD-RADIOLOGY WITH A NEW SET FOR CHILDREN. Schuster, W.; Sladek, W.; Heinrich, H. (Giessen Univ. (F. R. Germany). Zentrum fuer Radiologie; Siemens A. G.; Erlangen (F. R. Germany). Unternehmensbereich Medizinische Technik). Roentgen Bl.; 28: No. 10, 471-476(Oct 1975). (In German)

8 figs.; 1 tab.; 6 refs.

Possibilities of saving exposure in child-radiology are discussed: (a) strict image intensifier technique, (b) low dosage in screening, (c) low dosage films, (d) favorable geometric conditions in the set. The most important characteristics of a new radiology set for children are described and some results shown. (DE)

26229 RESULTS OF 125-I THERAPY OF THYROTOXICOSIS. Glanzmann, C.; Horst, W. (Zurich Univ. (Switzerland). Klinik und Poliklinik fuer Radiotherapie und Nuklearmedizin). Nucl.-Med.; 14: No. 3, 207-218(Aug 1975). (In German)

6 figs.; 6 tabs.; 23 refs.

About 100 patients with hyperthyroidism and diffuse goiter (gland weight not more than 60 g) were treated with an individually calculated dose of 125-Iodine. After a follow-up time between 1.5 and 2 years there are the following results: 82% of the patients are euthyroid and 18% are still hyperthyroid. Relapse rate was 10%. More than 30% of the residual or relapse hyperfunctions were T_3 toxicosis. The status of 125-Iodine in the treatment of thyrotoxicosis is discussed with regard to the necessity of a destructive therapy in the major part of the patients. Published results of 125-Iodine therapy are summarized. (DE)

26230 COMPUTER SIMULATION FOR THE IMPROVEMENT OF RADIOTHERAPY. Hehn, G.; Pfister, G.; Prillinger, G.; Boehm, J. K. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 204-213(1975). (In German)

20 figs.; 1 tab.; 31 refs.

The various possibilities of computer application in radiotherapy were demonstrated. Radiation transport programs routinely used in nuclear energy were adapted to simulate γ, electron, and neutron fields used in radiotherapy. After reproducing machine-dependent measured dose distribution in water the material composition in the phantom was changed to simulate inhomogeneity effects of interest in the patient. The largest effects are calculated for electrons but also for neutrons and γ rays the changes of dose distribution are of interest for treatment planning. The calculated dose matrices are approximated by analytical functions for use in the dose superposition code for treatment planning. Since in neutron therapy the knowledge of absorbed dose alone is insufficient, cell survival models were used to simulate isoeffect curves in addition to isodose curves for treatment planning. The program system applied for radiation therapy is described and computer simulation results are discussed. (DE)

26231 DIE HAFTPFLICHT FUER GENETISCHE STRAHLENSCHAEDEN. (The Liability for Genetic Radiation Damage). Bentzien, W. R. Studien Zum Internationalen Wirtschaftsrecht und Atomenergierecht. Goettingen, F. R. Germany; Goettingen Univ. Inst. fuer Voelkerrecht (1971). 213p. (In German)

With refs.

The main problem in liability cases is the proof of a relation of cause and effect between the damage suffered and the damaging person or process in an individual case. Furthermore, in cases of genetic damage, it remains doubtful whether all of the other factual preconditions specified in the liability standards have been fulfilled. Under these, a claim for damages is only valid if the plaintiff himself has been suffering personal damage. His descendants suffering from hereditary effects of radiation, on the other hand, have been ill from the beginning of their life, and the lesion is part of their personality. A civilized state which allows ionizing radiation to be used cannot leave these genetic victims without adequate compensation, as would be the case under the present liability legislation. The problem of whether and how the genetic effects of radiation can be provided for under liability laws at all is discussed, and some possible solutions are proposed. For completeness, references are made to Anglo-American and French legislation. (DE)

26232 MEMBERSHIP ASSOCIATION OF THE INTERNATIONAL RADIATION PROTECTION ASSOCIATION–IRPA. IRS Mitt.; 75: No. 1, 16-19(Mar 1975). (In German)

Tasks, scope of activities, membership, bodies and committees of the association which embraces the FRG, Switzerland, and Liechtenstein are detailed. (DE)

26233 SKIN'S-SURFACE-EXPOSURE BY MAKING LONG-CONE AND SHORT-CONE EXPOSURES. Van de Poel, A. C. M.; Groothedde, R. T. (Katholieke Univ., Nijmegen, Netherlands). Ned. Tijdschr. Tandheelk.; 80: 212-219(Jun 1973). (In German)

A comparison was made of the surface-exposures in R.cm^2 at the entrance of the x-ray beam in the skin as measured by (1) the short-cone technique (f-o = 10 cm) and (2) the long-cone technique (f-o = 45 cm). By the long-cone technique filmholders model Utrecht were also used; this type of filmholders possess an extra diaphragm. The lowest exposures were measured: by using the long-cone technique with a lead lined open tube and filmholders with an extra diaphragm and by using the Philips Oralix to change the plastic cone for a lead lined tube and by making bitewing radiographs from the premolar-molar region not to expose two dental films number 2 (3×4 cm) but one film number 3(2.6×5 cm) with diaphragm 3. (auth)

26234 WHOLE-BODY COUNTER. A Survey. II. Clinical Application. Koeppe, P. (Klinikum Steglitz, Berlin). Radiobiol. Radiother.; 16: No. 5, 491-510(1975). (In German)

Some uses of whole-body counters which are discussed are as follows: determination of radiation doses; determination of whole-body potassium; measurement of iron resorption which is significant in cases of iron deficiency; measurement of vitamin B_{12} resorption in relation to intrinsic factor production; bone metabolism studies; and iodine metabolism studies. Studies on in vivo neutron activation and evaluation of the clinical importance of the whole-body counter are also discussed. (HLW)

26235 GYNAECOLOGICAL MULTIAPPLICATOR ^{226}Ra. Vebersik, V. Sb. Lek.; 76: No. 10, 257-261(Oct 1974). (In Czech)

Gynaecological ^{226}Ra applicators in hitherto used modifications of basic classical methods are all fixed only intravaginally. This fixation does not ensure a constant position of the emitter throughout the period of application and does not meet the dosimetric plan and may even cause undesirable therapeutic complications. The author describes an applicator of his own design which ensures a constant position of the emitter throughout the period of irradiation. The gynaecological radium multiapplicator is made up of an external fixation equipment and a set of fittings which contain the radium emitters. Both are from synthetic materials. The set of fittings has wide use; when working with emitters containing 10 and 20 mg Ra-El 230 combinations can be produced which are dosimetrically constant and not affected by common movements of the patient. The technique of administration is simple and quick and thus the professional dose of irradiation is small. Cleaning and sterilization are done in the usual way. (auth)

26236 INFLAMMATORY REACTION IN THE RADIOTHERAPY OF BREAST CANCER. Hellriegel, W. (Katharinenhospitals der Stadt, Stuttgart). Z. Allg. Mikrobiol.; 49: 1697-1698(In German)

Scaring is one of the undesired side effects of surgery or radiotherapy of breast cancer. When delayed reactions of radiotherapy occur in five of the patients, then can be added teleangiectasis in the skin and mucosa, pigmentation variations with induration and scaring in the skin, epithelial defects, occasionally ulceration, and infected ulcers. The extent of the radiation reaction can not be predicted. Constitution, age, state of the skin, metabolic interferrences, local circulation problems, allergies, chemical irritation, and variations in the regional radiosensitivity determine the extent. Treatment for acute and chronic reactions are summarized. (tr-auth)

26237 RADIOTHERAPY OF BRONCHIAL CARCINOMA. Alth, G.; Koren, H. (Sonderabteilung fuer Strahlentherapie, Vienna). Wien. Med. Wochenschr.; 124: No. 47, 688-694(23 Nov 1974). (In German)

As a general rule radiotherapy of bronchial carcinomas is used only in inoperable cases and therefore the curative rate is quite

low. However as high voltage radiation has an analgesic effect, it allows the limited life of the patient to be livable. Radiotherapy in combination with chemotherapy has given some promising results. The technical and radiobiological planning for the radiotherapy are described. Indications for radiotherapy are summarized. (JSR)

26238 DOSE FIELDS IN IRRADIATION WITH BEAMS OF ELECTRONS OF A SMALL CROSS-SECTION AND IRREGULAR FORM. Skoropad, Yu. D.; Dmitrov, G. P.; Mardynskii, Yu. S. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 21: No. 1, 49-54(Jan 1976). (In Russian).

The authors studied the regularities of depth distribution of doses in irradiation with beams of electrons of small cross-section and irregular form. The essence of physical processes taking place during irradiation was established. A simple and rather precise method of transformation of symmetrical dose fields into nonsymmetrical and irregular ones was proposed. (auth)

26239 PECULIARITIES OF STROMATOGENIC REACTION IN RADIATION PATHOMORPHOSIS OF MALIGNANT TUMORS OF CERVIX UTERI. Gubareva, A. V.; Rukavishnikova, V. G.; Gebelov, A. A.; Seferyants, A. F. Central Scientific-Research Rentgeno-Radiology Inst., Leningrad). Med. Radiol.; 21: No. 1, 21-27(Jan 1976). (In Russian).

In intracavitary irradiation (γ radiation of ^{60}Co of the primary tumoral focus (cervix uteri cancer of the I–II stages) the authors observed previously (after 1 or 2 irradiations, the dose in points A and A_1 was 2000 to 4000 rad) strong damage of the tumor and its bed with a complete suppression of the cellular mesenchymal reaction. Such marked inhibition of the connective tissue activity remained both in the period of irradiation and during a long time after its completion. In teleirradiation (Luch-I) according to the method of interrupted courses which is used as the first stage of combined radiation therapy, the death of the parenchyma of the tumor was not accompanied by a noticeable damage of the stroma. On the contrary, after the first three irradiations (dose–1350 rad) the signs of the intensification of the connective tissue activity were discovered. It was possible to observe an active participation of mesenchymal elements in elimination of parenchyma of the tumor in the interval between the first and the second stages of the interrupted course of teleirradiation (cumulative dose 1800 rad). (auth)

26240 KINETICS OF THE INDICES OF NONSPECIFIC REACTIVITY OF PATIENTS WITH CERVIX UTERI CANCER DURING COMBINED RADIATION TREATMENT AND IMMUNOPROPHYLAXIS OF ITS COMPLICATIONS. Baraboy, V. A.; Abdullaev, V. D.; Yurechko, V. L. (Kiev Scientific-Research Rentgeno-Radiology and Oncology Inst.). Med. Radiol.; 21: No. 1, 27-35(Jan 1976). (In Russian).

Development of cervix uteri cancer is accompanied by the decrease of nonspecific reactivity (increase of the number of microorganisms and specific content of autoflora of the skin and decrease of its bactericidal action). Combined radiation treatment with the use of intracavitary applicators of a standard and increased activity is accompanied by a progressing deepening of immunodepression (data on 186 patients with cervix uteri cancer, mainly of the II and III stages and 25 healthy women). The use of immunostimuli—single vaccination by a liquid and dry vaccine BCG for two weeks before irradiation and also autohemotherapy before each intracavitary application considerably weakened the development of radiation immunodepression. Autohemotherapy and in a lesser degree vaccination with a liquid BCG vaccine decreased the incidence of the development of early complications (rectitis, cystitis, leukopenia, etc.). (auth)

26241 OCCUPATIONAL EXPOSURE TO IONIZING RADIATIONS IN CZECHOSLOVAKIA. Chysky, J.; Trousil, J. Radioisotopy; 15: No. 3, 367-373(Jun 1974). (In Czech).

The results of individual dosimetry carried out in Czechoslovakia between 1966 and 1970 were analyzed statistically. This analysis showed that the level of exposure was higher in industry (radiographic testing) than in the medical services, and that in the latter it was highest in the cancer treatment (radiotherapy) departments, and higher among female personnel. Exposure was also higher among the less skilled workers and in the larger plants. (CIS Abstr. Vol. 2)

26242 APPLICATION AND INTERPRETATION OF RADIOLOGICAL PROTECTION MEASURES. Guillouzic, G. Rayonnem. Ionis. Tech. Mes. Prot.; 5: No. 2, 63-81(Apr 1975). (In French).

From measurements, presented in 2 tables and discussed, made in a study of various radiological installations (vertical fluoroscopy, medical radiological diagnosis unit, operating theatre with facilities for radiological diagnosis, radiographic testing, radiocrystallography), the author draws the following conclusions: radiography is less dangerous than fluoroscopy, but personnel employed on both types of installation are liable to overexposure; a brilliance amplifier reduces risk in fluoroscopy, but the examination time is too long; the personnel of operating theatres is not sufficiently protected, their radiation being inadequately supervised; in radiographic testing, the distances from the source observed are not sufficient; in radiocrystallography, the local acute radiation hazard is greater than the over-all external radiation hazard. Recommendations: strict observance of radiological protection instructions and of good work practice; inspection of apparatus and installations, also when new; scrupulous use of lead aprons and of shields; strict limitation of personnel in vicinity of subject under examination; closure of lead-covered doors during examinations; use of cord extensions to take photographs at a distance; limitation of fluoroscopy time; systematic dosimetry. Discussion. (CIS Abstr. Vol. 2)

26243 RELATIONSHIP OF COLONY-STIMULATING ACTIVITY TO APPARENT KILL OF HUMAN COLONY-FORMING CELLS BY IRRADIATION AND HYDROXYUREA. Broxmeyer, H. E.; Galbraith, P. R.; Baker, F. L. (Queen's Univ., Kingston, Ont.). Blood; 47: No. 3, 403-411(Mar 1976).

Suspensions of human bone marrow cells were subjected to ^{137}Cs irradiation in vitro and then cultured in semisolid agar medium. Cultures of irradiated cells were stimulated with colony-stimulating activity (CSA) of different potencies, and it was found that the amount of stimulation applied to cultures influenced the apparent kill of colony-forming cells (CFC). It was also found that the effects of irradiation on colony formation were not confined to CFC kill since medium conditioned by cells during irradiation exhibited stimulatory and inhibitory properties after treatment by 600 and 1000 rads, respectively. Studies in which irradiated cells were pretreated with hydroxyurea indicated that CFC in the DNA synthetic phase of the cell cycle were particularly sensitive to low doses of irradiation. The proliferative capacity of CFC surviving 1000 rads was undiminished as judged by their ability to form large colonies. Estimates of CFC kill by hydroxyurea were also affected by the level of CSA. (auth)

26244 LATE NEOPLASTIC CHANGES FOLLOWING MEDICAL IRRADIATION. Hutchison, G. B. (Harvard School of Public Health, Boston, MA). Cancer, Suppl.; 37: No. 2, 1102-1107(Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

New additions since 1968 to the literature on radiation carcinogenesis in man support the earlier conclusion of an approximately linear increase in cancer incidence in a broad intermediate dose range for most sites of cancer. Questions are raised regarding the nature of the dose-response relation at very low and at very high dose exposures. Analyses of some data on exposure to radiation from internal deposits of radioactive material suggest that the dose-response curve at low and intermediate ranges is concave up, implying a smaller effect per unit exposure at very low doses than at intermediate ranges. Data on exposure to the very high but anatomically limited doses of radiation used in cancer therapy give conflicting results, suggesting in one report a continuation of the linear relation into the high-dose range. Other reports suggest a lesser effect per unit dose at high doses than at intermediate doses. Extensive laboratory studies of exposure of experimental animals indicate that over broad dose ranges, exceptions to simple linear relations are the rule, and that factors of dose rate and fractionation also affect the dose-response relation. (auth)

26245 EFFECTS OF GONADAL IRRADIATION IN CLINICAL RADIATION THERAPY: A REVIEW. Lushbaugh, C. C. (Oak Ridge Associated Universities, TN); Casarett, G. W. Cancer, Suppl.; 37: No. 2, 1111-1120(Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

Recent improvements in radiation therapy of some malignancies in lower abdominal sites are leading to prolongation of life in persons of child-bearing age. These successes require an evaluation of the possible undesirable consequences of the unavoidable gonadal irradiation that occurs in these cases. A review of radiobiological data from experimental animal studies and retrospective clinical studies suggests that in most instances human gonadal exposures in both sexes are insufficient to cause permanent sterility, because the exposures are fractionated and the total gonadal dose is much less than 600 rads. As a consequence, return of fertility must be anticipated, and the worrisome questions of radiation-induced genetic damage in subsequent pregnancies

must be addressed. This review did not substantiate this fear, because no case reports could be found of malformed infants among the progency of previously irradiated parents. Some experimental studies suggest that radiation-damaged spermatogonia are self-destructive, but any evidence for this phenomenon in the ovary is nonexistent. We suggest that the difference between fact and theory here may be the mathematical result of the interplay of low probability for occurrences and the few patients who until now have survived long enough for study. (auth)

26246 HISTOPATHOLOGICAL BASIS FOR FUNCTIONAL DECREMENTS IN LATE RADIATION INJURY IN DIVERSE ORGANS. White, D. C. (Inst. of Pathology, Washington, DC). Cancer, Suppl.; 37: No. 2, 1126-1143 (Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

As more and more patients respond favorably to combined cancer therapies, the time of survival from radiotherapy will become the most important single factor in the incidence and progression of late radiation changes. The late sequelae of irradiation are the sum of the following: (1) residua of the direct and indirect early changes in responsive cell populations; (2) progressive vascular sclerosis with its associated effect upon connective tissue and the parenchymal cells; and (3) the reactive or replacement connective tissue proliferation which is responding to (1) and (2). From this it may be seen that further investigative efforts need direction toward: (1) reducing the magnitude and permanence of the early principal parenchymal cell injury; (2) diminishing the severity of the early microvascular change which adds significantly to the early parenchymal cell damage; (3) determining the mechanics of the progressive vascular sclerosis with a view to retarding this effect; and (4) lessening the reactive fibrosis. (auth)

26247 SQUAMOUS CELL CARCINOMA OF THE ORAL TONGUE AND FLOOR OF MOUTH. Evaluation of Interstitial Radium Therapy. Delclos, L.; Lindberg, R. D.; Fletcher, G. H. (Univ. of Texas System Cancer Center, Houston). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 126: No. 2, 223-228 (Feb 1976).

From 57th annual meeting of the American Radium Society; Isla Verde, Puerto Rico (4 May 1975).

From January 1965, to December 1972, 46 patients with squamous cell carcinoma of the floor of the mouth and 102 patients with squamous cell carcinoma of the oral tongue were treated at M. D. Anderson Hospital and Tumor Institute by interstitial irradiation alone or in combination with external irradiation. Through the years the combination of radiation therapy modalities has been adjusted in an attempt to improve local control, keeping complications to a minimum. In this paper we analyze local control, causes of failure and complications as related to the primary size (T Stage) and radiation therapy techniques employed. (auth)

26248 COMBINED RADIATION THERAPY AND 5-FLUOROURACIL FOR ADVANCED SQUAMOUS CELL CARCINOMA OF THE ORAL CAVITY AND OROPHARYNX: A RANDOMIZED STUDY. Lo, T. C. M.; Wiley, A. L., Jr.; Ansfield, F. J. (Univ. of Wisconsin, Madison). Am J. Roentgenol., Radium. Ther. Nucl. Med.; 126: No. 2, 229-235 (Feb 1976).

From 57th annual meeting of the American Radium Society; Isla Verde, Puerto Rico (4 May 1975).

In 1961, a randomized study was begun at the University of Wisconsin Medical Center in which the treatment of advanced squamous cell carcinoma of the head and neck with radiation therapy was compared with combined treatment with radiation therapy and 5-Fluorouracil. One hundred and thirty-six patients with primary lesions in the oral cavity, the base of the tongue, and the oropharynx were analyzed. Both local control and survival were better in the combined treatment group than in the group with radiation therapy alone. However, in only the oral cavity patient population was the difference statistically significant. Both acute and late complications were also increased in this group of patients who received combined treatment. (auth)

26249 EFFECT OF THERAPEUTIC IRRADIATION ON THE IMMUNE RESPONSES. Slater, J. M.; Ngo, E.; Lau, B. H. S. (Loma Linda Univ., CA). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 126: No. 2, 313-320 (Feb 1976).

From 57th annual meeting of the American Radium Society; Isla Verde, Puerto Rico (4 May 1975).

The immune responses of 60 patients undergoing therapeutic irradiation were evaluated according to four anatomical sites irradiated. In vitro lymphocyte transformation tests with PHA, Con-A, and PWM and quantitative assays of IgG, IgA, and IgM were performed on blood obtained from each patient before and during therapy, and two weeks, two months, and six months after therapy. At these same testing intervals, skin tests with PPD, mumps antigen, Candida antigen, and SD-SK were performed. During irradiation, the mean values of all lymphocyte transformation tests were depressed, varying from 48 percent to 64 percent of pretreatment baseline. This depression persisted until about two months after completion of treatment. By six months, response rose to pretreatment values. When response was evaluated according to sites irradiated with all mitogens, the pelvic and pelvic plus abdominal groups showed consistently greater depression than the chest or head and neck groups. Radiation effected no significant changes in the mean values of IgG, IgA or IgM. A decrease in skin sensitivity was noted during radiation; 73 percent of the subjects responded positively before therapy while only 53 percent had at least one positive test during therapy. By two months postirradiation, 73 percent of the group clinically free of disease had positive skin tests. A comparison of clinical condition with test results is significant when one considers the 17 patients who developed metastatic disease or died from disease. The depression for all three mitogens during radiation therapy was greater for this group. Of the 17, only four had IgG levels in the normal range, and consistently fewer positive skin tests were demonstrated. (auth)

26250 INITIAL COMPARATIVE RESPONSE TO PEAK PIONS AND X RAYS OF NORMAL SKIN AND UNDERLYING TISSUE SURROUNDING SUPERFICIAL METASTATIC NODULES. Morton, M.; Kligerman, M.; West, G. (Univ. of New Mexico, Albuquerque). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 126: No. 2, 261-267 (Feb 1976).

From 57th annual meeting of the American Radium Society; Isla Verde, Puerto Rico (4 May 1975).

Given the limitations of available material and methods for measuring skin response, the relative biological effectiveness (RBE) for the development and healing of skin reaction to pions in this experiment is 1.43. This is based on data obtained from a patient with malignant melanoma, in whom multiple skin nodules and the surrounding normal skin were randomized into three dose levels for pions and x-rays. The RBE for skin reaction was obtained while the skin tumor nodules appeared to regress at least as rapidly with pion therapy as with x-rays. Without benefit of adequate observation of time required for nodule regrowth, any estimate of tumor RBE is speculative. (auth)

26251 GROWTH HORMONE DEFICIENCY IN CHILDREN WITH BRAIN TUMORS. Shalet, S. M.; Beardwell, C. G.; Morris-Jones, P.; Bamford, F. N.; Ribeiro, G. G.; Pearson, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Cancer, Suppl.; 37: No. 2, 1144-1148 (Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

Nine children with brain tumors are described who have received various combinations of treatment, including surgery, radiotherapy, and chemotherapy. Many of the children were noted to be of short stature. Endocrine assessment was carried out from 2 to 10 years after treatment. The combined results of insulin tolerance and Bovril stimulation tests show an impaired growth hormone response in six of the nine children. Bone age is retarded in all cases, and the present height is below the 10th percentile in five of the six. The cause of this growth hormone deficiency is obscure, but further studies are in progress. (auth)

26252 RESIDUAL DISABILITIES IN CHILDREN TREATED FOR INTRACRANIAL SPACE-OCCUPYING LESIONS. Bamford, F. N. (Univ. of Manchester, Eng.); Jones, P. M.; Pearson, D.; Ribeiro, G. G.; Shalet, M.; Beardwell, C. G. Cancer, Suppl.; 37: No. 2, 1149-1151 (Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL. USA (9 Jan 1975).

A retrospective study of 30 long-term survivors of cranial or craniospinal irradiation for intracranial space-occupying lesions has demonstrated physical and mental handicaps in the majority. This is most severe in those cases treated before the age of 11 years, and is not confined to those children having craniospinal or whole-brain irradiation. The mental handicap also appears to be progressive, but cannot be easily examined in this retrospective study. (auth)

26253 LONG-TERM EFFECTS OF EXTERNAL RADIATION ON THE PITUITARY AND THYROID GLANDS. Fuks, Z.; Glatstein, E.; Marsa, G. W.; Bagshaw, M. A.; Kaplan, H. S. (Stanford Univ. School of Medicine, CA). Cancer, Suppl.; 37: No. 2, 1152-1161 (Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

Chronic damage following external irradiation of the normal pituitary and thyroid glands, delivered incidentally during radio-

therapy of neoplasms of the head and neck may be more common than has been appreciated in the past. A case of a child who developed pituitary dwarfism 5½ years after radiation therapy had been delivered for an embryonal rhabdomyosarcoma of the nasopharynx is described. A review of similar cases from the literature is presented. Likewise, external irradiation of the normal thyroid gland produces a spectrum of radiation-induced syndromes. Clinical damage to the pituitary and thyroid glands is usually manifested months to years after treatment and is preceded by a long subclinical phase. A careful exclusion of these glands from radiation treatment fields is recommended whenever possible. An early detection of endocrine function abnormalities in patients receiving radiation to these glands is desirable, since appropriate treatment may prevent the late deleterious effects of external irradiation of the pituitary and thyroid glands. (auth)

26254 LATE EFFECTS OF THERAPEUTIC IRRADIATION ON THE SKELETON AND BONE MARROW. Parker, R. G.; Berry, H. C. (Univ. of Washington Hospital, Seattle). Cancer, Suppl.; 37: No. 2, 1162-1171 (Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL USA (9 Jan 1975).

Sequelae in the skeleton and bone marrow can be important late consequences for survivors following radiation therapy of cancer. Skeletal sequelae of radiation therapy often are predictable, although they may not be avoidable. The growth suppressive effects of therapeutic irradiation may occur in any bone, but most often are noted in the spine after doses in excess of 2000 rads. Mature bone and cartilage may be devitalized by irradiation without clinical consequence until stressed. Although malignant tumors may arise in irradiated bone and cartilage, the risk is minimal and is readily accepted in modern-day radiation oncology. Radiation-induced suppression of bone marrow function usually is of immediate rather than late consequence; however, functional recovery after therapeutic irradiation, while prolonged, is more complete than formerly thought. Leukemia rarely develops secondary to therapeutic irradiation. (auth)

26255 DECREASED RISK OF RADIATION-ASSOCIATED SECOND MALIGNANT NEOPLASMS IN ACTINOMYCIN-D-TREATED PATIENTS. D'Angio, G. J.; Meadows, A.; Mike, V.; Harris, C.; Evans, A.; Jaffe, N.; Newton, W.; Schweisguth, O.; Sutlos, W.; Morris-Jones, P. (Children's Hospital of Philadelphia). Cancer, Suppl.; 37: No. 2, 1177-1185 (Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

One hundred two long-term survivors of childhood cancers with second malignant neoplasms (SMNs) were collected from 10 institutions. Forty-seven cases fulfilling study criteria were studied to determine the risk of developing a SMN in irradiated fields after exposure to various chemotherapeutic agents. The case control method was used. The risk of developing such tumors was decreased by a factor of 7 in patients receiving antinomycin-D (AMD). The protective effect of AMD was more pronounced in patients receiving repeated courses of the agent. No change in relative risk was found for children given antifolates, the vinca alkaloids, or alkylating agents. AMD protection is an unexpected finding because the agent is an oncogen in animals and an enhancer of radiation, the latter being a known carcinogen. Possible mechanisms, which remain speculative, are discussed. These results indicate the need for careful long-term observation of cancer survivors to gain understanding of the late effects of multimodal treatments. (auth)

26256 QUANTIFICATION OF COMBINED RADIATION THERAPY AND CHEMOTHERAPY EFFECTS ON CRITICAL NORMAL TISSUES. Phillips, T. L.; Fu, K. K. (Univ. of California, San Francisco). Cancer, Suppl.; 37: No. 2, 1186-1200 (Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

In order to determine the modification of radiation effect on critical normal tissues which occurs with combinations of radiation and cancer chemotherapy, a review of laboratory and clinical data has been carried out. Information on 10 different normal tissues is available. It is clear that the antibiotic cancer chemotherapeutic agents are the most likely to enhance radiation injury, with increased levels reported in all tissues except the central nervous system. The second most common type of injury with combination therapy appears to occur with drugs causing injury to the normal tissue on their own, such as adriamycin in the heart and methotrexate in the central nervous system. Quantification of the dose-effect factor is only available on a limited number of tissues and, primarily, in experimental animals. From these limited data, it is clear that dose-effect factors between 1.1 and 1.8 are seen, indicating that radiation doses must be reduced by 10 to 80 percent for the same level of injury when combined with chemotherapy. The augmentation of radiation damage by cancer chemotherapeutic agents is a serious problem in a wide range of tissues, but a problem which can be dealt with by accurate knowledge as to the dose-effect factor and appropriate modification of the radiation treatment. (auth)

26257 ACUTE AND LATE EFFECTS ON NORMAL TISSUES FOLLOWING COMBINED CHEMO- AND RADIOTHERAPY FOR CHILDHOOD RHABDOMYOSARCOMA AND EWING'S SARCOMA. Tefft, M.; Lattin, P. B.; Jereb, B. (Memorial Sloan-Kettering Cancer Center, New York). Cancer, Suppl.; 37: No. 2, 1201-1213 (Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

Twenty-three patients with rhabdomyosarcoma and 15 patients with Ewing's sarcoma, treated with radiation therapy to the local site and systemic multiagent chemotherapy are described. Acute reactions from combination chemotherapy and radiation therapy were noted in both groups of patients. These reactions often appeared after low doses of irradiation, required unplanned interruptions of treatments, and in some patients, led to discontinuation of radiation therapy. The chronic effects on normal tissues in both groups of patients have been severe in several cases. (auth)

Vertebrates

Refer also to abstract 26129.

26258 (AD/A-006428) EFFECTS OF ^{60}Co ON ELECTRICAL SELF-STIMULATION OF THE BRAIN AND BLOOD PRESSURE. Topical Report. Bruner, A. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. (USA)). 13 Dec 1974. Contracts DASA01-70-C-0059; DNA001-74-C-0098. 27p. NTIS $3.75.

The effects of 1000- and 2000-rad ^{60}Co on electrical self-stimulation of subcortical brain areas and blood pressure were investigated to determine whether radiation-induced performance decrement occurs in a like manner for a positively rewarded behavioral task as it does for the more typically studied shock-avoidance task. During the early post-radiation minutes, self-stimulation responses decreased or ceased and resumed shortly thereafter, revealing a similar course of performance decrement as seen with shock-avoidance, discrimination tasks. Early post-radiation hypotension with subsequent recovery paralleled the performance decrement, reproducing the blood pressure-behavior correlations seen previously with shock reinforcement. The blood pressure elevating influence of the brain stimulation observed prior to irradiation was diminished or absent during the deep hypotensive stage post-radiation, but tended to return minutes later. (GRA)

26259 (CRSSA-1973, pp 63-67) AUTOHISTORADIOGRAPHIC STUDY OF THE PERI-FRACTURAL PERIOSTEAL REACTION AFTER WHOLE-BODY IRRADIATION IN MICE. Deloince, R.; Rue, G.; Drouet, J.; Richard, M.; Nguyen, T. L. [nd]. (In French)

In Centre de Recherches du Service de Sante des Armees. 1973 scientific works. (Centre de Recherches du Service de Sante des Armees, 75-Paris (France)).

This morphological analysis shows the starting up of fracture-stimulated cellular cycles of the periosteum, at the 18th hour for the reference and the 24th hour in the irradiated specimen. A difference in aspect was also observed between the periosteal cells of the standard and those of the irradiated subject during the first forty-eight hours following the fracture. Moreover the percentage of cells showing tritiated thymidine incorporated by the nucleus remains constantly lower in irradiated mice than in reference animals during the first forty-eight hours after fracture. (FR)

26260 (CRSSA-1973, pp 68-70) HISTOENZYMOLOGICAL STUDY OF PERIOSTEAL AND MUSCULAR VASCULARIZATION DURING A FRACTURE IN IRRADIATED MICE. Drouet, J.; Mailland, M.; Deloince, R. [nd]. (In French)

In Centre de Recherches du Service de Sante des Armees. 1973 scientific works. (Centre de Recherches du Service de Sante des Armees, 75-Paris (France)).

In this histoenzymological study the periosteal and muscular vessel network was localized precisely. The technique of revealing ATPase activity allows a better interpretation of topographical colorations. Arteriole and capillary lesions were detected on the fourth day in animals subjected to a fracture combined with a 650 rad whole-body irradiation as compared with mice suffering only from fracture. Muscle capillaries on the other

hand seem insensitive to irradiation within the limits of the method. (FR)

26261 (CRSSA-1973, pp 74-75) EFFECT OF γ IRRADIATION COMBINED WITH A FRACTURE ON THE PLASMA LACTICODEHYDROGENASE OF RABBITS. Drouet, J.; Dubos, M.; Haeffner, D.; Gril, J. P.; Charbonneau, P.; Goyffon, M. [nd]. (In French)

In Centre de Recherches du Service de Sante des Armees. 1973 scientific works. (Centre de Recherches du Service de Sante des Armees, 75—Paris (France)).

The plasma L.D.H. fraction in rabbits irradiated at a dose of 500 rads remains unchanged during the fourteen days following irradiation. An experimental fracture on the other hand leads to a strong increase in the L.D.H. activity 24 hours after the injury, with a quick return to normal, the phenomenon being aggravated if the injury is combined with an irradiation. (FR)

26262 (CRSSA-1973, pp 76-77) CHANGE IN THE MINERALIZATION OF THE HEALING BONE CALLUS AFTER WHOLE-BODY IRRADIATION IN MICE. Drouet, J.; Pleinard, J. F.; Nguyen, T. L.; Goyffon, M. [nd]. (In French)

In Centre de Recherches du Service de Sante des Armees. 1973 scientific works. (Centre de Recherches du Service de Sante des Armees, 75—Paris (France)).

The delayed consolidation of diaphysial long-bone fractures in mice subjected to whole-body x irradiation is expressed biochemically by a faulty mineralization of the repair callus. This deficiency is proportional to the irradiation intensity and is not corrected by previous administration of cysteamine. (FR)

26263 EFFECTS OF X-IRRADIATION ON THE POSTNATALLY-FORMING GRANULE CELL POPULATIONS IN THE OLFACTORY BULB, HIPPOCAMPUS, AND CEREBELLUM OF THE RAT. Bayer, S. A.; Altman, J. (Purdue Univ., West Lafayette, IN). Exp. Neurol.; 48: 167-174(1975).

Beginning on the second postnatal day, either two (2X group), four (4X group) or six (6X group) daily or alternate daily exposures to low-level x irradiation (150-200 R) were used to interfere with the acquisition of granule cells in the olfactory bulb, hippocampus, and cerebellum of the rat. At 60 days of age, the relationship between post-irradiation recovery and permanent granule cell loss was assessed with two quantitative techniques. First, the total number of granule cells was determined to estimate the magnitude of permanent loss. Secondly, the number of labeled granule cells were counted on day 60 after a ^{3}H-thymidine injection given on either day 15 or on day 20 to estimate differential rates of cell proliferation during the recovery period. Permanent loss of granule cells was sustained in all regions by all schedules of irradiation. The time for the most effective exposures was earlier in the hippocampus and olfactory bulb than in the cerebellum. In all regions, both the irradiated groups and the controls showed a decrease in the level of cell proliferation between 15 and 20 days. The number of cells that could be labeled after either the 15 or 20 day injection was below control levels for all groups in the hippocampus, at control levels for all groups in the cerebellum, and either at (2X and 4X) or below (6X) control levels in the olfactory bulb. These results are discussed in the light of the formation time of the granule cells in each region. (auth)

26264 ONCOGENIC RESPONSE OF RATS WITH X-RAY-INDUCED MICROCEPHALY TO TRANSPLACENTAL ETHYLNITROSOUREA. Warkany, J.; Mandybur, T. I.; Kalter, H. (Univ. of Cincinnati Coll. of Medicine). J. Natl. Cancer Inst.; 56: No. 1, 59-64(Jan 1976).

The relation of congenital malformations to tumor development was examined. Pregnant Sprague-Dawley rats were given 200 rads of X-rays on the 15th or 16th day of gestation and injections of 10 mg ethylnitrosourea (ENU)/kg 1-4 days later, or they were irradiated or injected only. Surviving weanlings that had been irradiated had micrencephaly and other malformations. Offspring exposed to ENU only had no external deformities. By 15 months of age 16.7 percent of the offspring exposed to X-rays and ENU prenatally had developed neurogenic tumors, whereas 62.2 percent of those exposed to ENU alone had developed tumors. Those only irradiated had no tumors. Both of the former groups developed oligodendrogliomas, mixed gliomas, ependymomas, and schwannomas, but the first manifestations of tumors occurred later in the group receiving the combined treatment. This delay persisted during the subsequent period of the study. (auth)

26265 THYROIDAL RADIOIODINE EXPOSURE OF THE FETUS. Book, S. A.; Goldman, M. (Univ. of California, Davis). Health Phys.; 29: No. 6, 874-877(Dec 1975).

Thyroid glands of developing fetuses are highly susceptible to radiation damage following maternal assimilation of radioiodines from nuclear fission or from medical diagnostic or therapeutic administration. The facility with which radioiodine is transported across the placenta assures fetal exposure to maternal radioiodine; the initiation of thyroid function in the young prior to parturition results in thyroidal concentration of radioiodine. Work in this field by a number of workers is correlated. The onset of radioiodine concentration by fetal thyroid glands for a number of mammals is tabulated. Fetal/maternal ratios of thyroidal ^{131}I concentration following (a) a single maternal administration and (b) chronic maternal exposure, are shown graphically for various mammals. (UK)

26266 BONE AND BONE MARROW SPACES IN DOSIMETRY OF BEAGLE SKELETONS. Momeni, M. H.; Pool, R. R. (Univ. of California, Davis). Health Phys.; 29: No. 6, 877-881(Dec 1975).

Following previously reported work on temporal and spatial distribution of ^{90}Sr–^{90}Y and of ^{226}Ra in beagle humeri and skeleton, bone space parameters (surface, volume, and trabecular thickness) are here presented. Measurements were carried out by a coupled microscope-computer system. Implications of the bone space dimensions on local ^{90}Y–^{90}Sr and ^{226}Ra dose to osteogenic and hematopoietic elements are discussed. (UK)

26267 COMBINED EFFECT OF LEAD AND ULTRAVIOLET RADIATION ON THE CONCENTRATION OF NUCLEIC ACIDS AND RESIDUAL NITROGEN IN THE BLOOD AND TISSUE OF RATS. Kareva, V. A. Gig. Naselennykh Mest; 12: 139-141(1973). (In Russian).

Rats were maintained under various regime conditions of light; the absence of light, light deficit ($^{1}/_{15}$ biodose of UV radiation), light near normal (0.5 biodose UV radiation) and an excess (2 biodoses of UV radiation). Some of the animals of each group were also exposed to lead (2 or 20 mg/kg in the form of acetate in the drinking water). It was shown that UV radiation did not influence the concentration of nucleic acids in the liver, but stimulated their synthesis in the mucous of the small intestine. The administration of lead in doses of 2 mg/kg did not change the concentration of nucleic acids in both tissues studied, but in doses of 20 mg/kg there was a slight increase. The combined effect of UV radiation and lead in doses of 2 mg/kg indicated an enhanced reaction on the biosynthesis of nucleic acids in the liver and mucous of the intestines but at doses of 20 mg/kg lead, this effect was absent. Administration of both doses of lead did not change but the UV radiation (0.5 and 2 biodoses) did show differences in connection with lead intoxication and decreased the amount of residual nitrogen in the blood. It may be concluded that the UV radiation, combined with different degrees of lead intoxication, shows a relatively protective influence on the process of the synthesis of protein. (Ref. Zh.)

26268 CYTOLOGICAL DETECTION OF MUTAGEN-CARCINOGEN EXPOSURE BY SISTER CHROMATID EXCHANGE. Perry, P.; Evans, H. J. (Medical Research Council, Edinburgh). Nature (London); 258: No. 5531, 121-125(13 Nov 1975).

A staining technique that detects sister chromatid exchanges has been used to examine the response of chromosomes in cultured Chinese hamster cells to a wide variety of mutagens-carcinogens. The test gives a very sensitive and rapid method for detecting chromosome mutagenicity of chemical agents and x rays and provides a powerful new method for detecting environmental mutagens. Details of the techniques are described. (auth)

26269 THYROIDITIS IN T CELL-DEPLETED RATS. Influence of Strain, Radiation Dose, Adjuvants and Antilymphocyte Serum. Penhale, W. J.; Farmer, A.; Irvine, W. J. (Royal Infirmary, Edinburgh). Clin. Exp. Immunol.; 21: No. 3, 362-375 (Sep 1975).

Strain differences in susceptibility to the development of thyroiditis following adult thymectomy and repeated sublethal x irradiation (4 × 200 rad) were investigated in the rat. Marked strain variation was noted, with AUG and PVG/c rats having the highest incidence and severity of lesion (100 and 80% respectively) whilst CAM rats had a low incidence (9%). WAG and LIS rats occupied an intermediate position. A combination of thymectomy, three doses of 200 rad, and a development period of 8 weeks were found to be the optimum conditions for induction of severe thyroiditis together with high antibody titres to thyroglobulin. These findings add support for the role of thymus-derived cells in the regulation of autoimmune responses and further suggest that thymectomy, combined with a series of sublethal irradiation, causes a selective depletion of those T cells specifically involved in the suppression of autoimmune reactivity to thyroid components, whilst leaving autoreactive helper T cells unimpaired. (auth)

26270 SENSITIVITY TO RADIATION AND CYCLE-ACTIVE DRUGS AS A FUNCTION OF STEM CELL COMPARTMENT REPLETION. Degowin, R. L.; Gibson, D. P. (Univ. of Iowa, Iowa City). J. Lab. Clin. Med.; 87: No. 2, 320-326(Feb 1976).

We have studied the sensitivity of normal mouse hemopoietic tissue to radiation and cycle-active drugs in relation to stem cell compartment repletion. Recovery of erythropoiesis in endogenous spleen colonies, blood reticulocytes, and 30-day survivals were determined in mice after an initial large dose of partial-body irradiation. We found that the normal stem cell compartment is more sensitive to cycle-independent modes of therapy, like radiation and cyclophosphamide, than it is to cycle-active agents like cytosine arabinoside and methotrexate. The depleted stem cell compartment exhibits marked sensitivity to cycle-independent agents but less to cycle-active agents, which, however, suppress its recovery more than they do the normal. The overshoot phase of recovery is relatively resistant to either cycle-independent or cycle-active agents. A reticulocytosis following a reticulocytopenia signals the overshoot phase of stem cell compartment recovery and relatively increased resistance. These findings may prove useful in designing chemotherapy regimens and in anticipating marrow recovery in planning for supportive care in patients with neoplastic disease. (auth)

26271 EFFECTS OF X IRRADIATION ON THE POSTNATALLY-FORMING GRANULE CELL POPULATIONS IN THE OLFACTORY BULB, HIPPOCAMPUS, AND CEREBELLUM OF THE RAT. Bayer, S. A.; Altman, J. (Purdue Univ., Lafayette, IN). Exp. Neurol.; 48: No. 1, 167-174(Jul 1975).

Beginning on the second postnatal day, either two (2X group), four (4X group) or six (6X group) daily or alternate daily exposures to low-level x irradiation (150 to 200 R) were used to interfere with the acquisition of granule cells in the olfactory bulb, hippocampus, and cerebellum of the rat. At 60 days of age, the relationship between post-irradiation recovery and permanent granule cell loss was assessed with two quantitative techniques. First, the total number of granule cells was determined to estimate the magnitude of permanent loss. Secondly, the number of labeled granule cells were counted on day 60 after a ^{3}H-thymidine injection given on either day 15 or on day 20 to estimate differential rates of cell proliferation during the recovery period. Permanent loss of granule cells was sustained in all regions by all schedules of irradiation. The time for the most effective exposures was earlier in the hippocampus and olfactory bulb than in the cerebellum. In all regions, both the irradiated groups and the controls showed a decrease in the level of cell proliferation between 15 and 20 days. The number of cells that could be labeled after either the 15 or 20 day injection was below control levels for all groups in the hippocampus, at control levels for all groups in the cerebellum, and either at (2X and 4X) or below (6X) control levels in the olfactory bulb. These results are discussed in the light of the formation time of the granule cells in each region. (auth)

26272 TRANSFER OF ADOPTIVE IMMUNITY TO TUBERCULOSIS IN MICE. Lefford, M. J. (Trudeau Inst., Saranac Lake, NY). Infect. Immun.; 11: No. 6, 1174-1181(Jun 1975).

A system is described for studying adoptive immunity to tuberculosis in syngeneic mice. Donor mice were immunized with 10^{4} BCG intravenously, and lymphoid cells were harvested 28 days later. Adoptive immunity was measured in recipient mice in terms of the inhibition of growth of BCG in the liver and spleen following intravenous injection. Adoptive immunity was expressed optimally when recipients were sublethally irradiated (500 R), challenged with 10^{4} to 10^{5} viable organisms, and given sensitized lymphoid cells intravenously. Adoptive immunity was not manifest until 14 days after challenge and was effective against Mycobacterium tuberculosis H37Rv as well as BCG. Immunity could be conferred by spleen, lymph node, peritoneal exudate, and resident peritoneal (washout) cells. The lymphoid cells conferring immunity were shown to be thymus-dependent lymphocytes by virtue of their nonadherence to glass wool and sensitivity to anti-theta serum plus complement. The sensitized cells were relatively susceptible to both in vitro and in vivo x irradiation. (auth)

26273 ACID-beta-GLYCEROPHOSPHATASE REACTION PRODUCTS IN THE CENTRAL NERVOUS SYSTEM MITOCHONDRIA FOLLOWING X-RAY IRRADIATION. Roizin, L. (New York State Psychiatric Inst., NY); Orlovskaja, D.; Liu, J. C.; Carsten, A. L. J. Histochem. Cytochem.; 23: No. 6, 402-410 (Jun 1975).

A survey of the literature to date on the enzyme histochemistry of intracellular organelles has not yielded any reference to the presence of acid phosphatase reaction products in the mammalian mitochondria of the central nervous system. A combination of Gomori's acid phosphatase method, however, with standard electron microscopy has disclosed the presence of enzyme reaction products in the mitochondria of the central nervous system of rats from 2 hr to 22 weeks after x-ray irradiation, as well as in a cerebral biopsy performed on a patient affected by Huntington's chorea. No enzyme reaction products, on the other hand, were observed in serial sections that had been incubated in substrates either containing sodium fluoride or lacking in beta-glycerophosphate. The abnormal mitochondrial enzyme reaction (chemical lesion) is considered to be the consequence of the pathologic process affecting the ultrastructural-chemical organization of the organelle. (auth)

26274 THE HEMATOLOGICAL EFFECTS OF IRRADIATION ON THE INDIAN DESERT GERBIL (MERIONES HURRIANAE JERDON). Malhotra, N.; Srivastava, P. N. (Jawaharlal Nehru Univ., New Delhi (India). School of Life Sciences). Strahlentherapie; 150: No. 3, 344-349(Sep 1975).

7 figs.; 15 refs.

Male adult gerbils were irradiated with a whole-body dose of 600 R with γ-rays. The animals were studied for their hematological response on days, 1, 2, 3, 7, 14, and 28 post irradiation. No significant change was noted in erythrocyte number after irradiation. There was a slight fall in hemoglobin and hematocrit values in the early post-irradiation periods. A transient leukocytosis was observed on day 1 after irradiation followed by a sharp fall on day 2 which continued up to day 3. A recovery in leukocyte value was noted after a week of irradiation. Abnormal leukocytes were noted in the peripheral blood on day 2 after irradiation. The results show that the gerbil is radioresistent and is comparable to the rabbit at this dose level. (DE)

26275 PROTECTIVE EFFECT OF A MIXTURE OF RADIOPROTECTOR SUBSTANCES (MEXAMINE AND CYSTAMINE) ON THE HAEMATOPOIETIC STEM CELLS OF MICE. Vacek, A.; Sikulova, J.; Rakova, A. (Ceskoslovenska Akademie Ved, Brno. Biofysikalni Ustav). Strahlentherapie; 150: No. 3, 336-343(Sep 1975).

6 figs.; 1 tab.; 21 refs.

A protective effect of the mixture of radioprotectors (mexamine and cystamine) on the haematopoietic stem cells of the spleen and bone marrow was studied in mice irradiated by a dose 700 R in different time intervals after intraperitoneal injections of substances. The protective effect of the mixture against the lethal radiation effects outlasts till the 90th minute after the injection, as well as the protection of the haematopoietic stem cells in the bone marrow. D_0 of the regression lines of the survival of endogenous colonies in the spleen (ESC) increases up to 340 R after irradiating the mice in the 15 min interval after the injection of the protective substances with a subsequent decrease to the level of the control group (100 R). The D_0 value of CFU survival in the bone marrow does not change; however, in the interval up to 60 min after the injection complete preparation of the radiation damage takes place after an exposure to 100 R. The recovery from the damage to the erythropoiesis followed by an incorporation of ^{59}Fe into the bone marrow and spleen is the faster the higher a number of CFU survived the used radiation dose. The importance of a decrease of the radiation damage to the small intestine for the total protective effect of the mixture of radioprotectors is discussed. (DE)

26276 CHROMOSOME ABERRATIONS IN SOMATIC AND GERM CELLS FOLLOWING 300 r X RAYS TO RABBITS. Benova, D.; Vuglenov, A.; Baev, I. (Research Inst. of Radiobiology and Radiation Hygiene, Sofia). C. R. Acad. Bulg. Sci.; No. 8, 1133-1136(1975).

The chromosome aberration yield in lymphocytes was compared to that in spermatogonia following exposure of rabbits to 300 R of x rays. The results indicate that the dicentrics observed per lymphocyte (0.17) by far exceeded the translocations recovered per spermatogonia (0.025). The investigation showed a relation between production of chromosome aberrations in peripheral lymphocytes and in spermatogonia, which makes it possible to estimate the genetic risk caused by irradiation. (ERB)

26277 INFLUENCE OF X-RAYS ON THE DEPOLYMERISATION SPEED OF FIBRES OF LATHYRIC COLLAGEN RECONSTITUTED IN VITRO. van Caneghem, P.; Lapiere, C. M. (Liege Univ. (Belgium). Lab. de Radiobiologie). C. R. Soc. Biol.; 169: No. 1, 242-245(1975). (In French)

Irradiation of native collagen from lathyric rats, in solution, reduces the depolymerization speed in the cold of fibres formed by gelification at 37°C, rendering it thus comparable to the speed observed with normal collagen. In our test this normalization does not appear if the collagen is irradiated in the state of gel. These observations and the absence of specific modifications induced by irradiation in the presence of reagents of the aldehydes speak in favor of the interference, on irradiation, of chemical groups different from the physiological aldehyde groups. (FR)

26278 MODIFICATION OF CANCER CELLS RADIOSENSITIVITY. III. Influence of the Crabtree Effect on Radiosensitivity of Yoshida Sarcoma Solid Tumors. Watras, J.; Widel, M. (Inst. of Oncology, Gliwice, Poland). Radiobiol. Radiother.; 16: No. 5, 581-587(1975).

Intravenous injections of glucose, 1 g/kg of rats body weight, 5 minutes before each irradiation (10 × 300 R) do not increase the radiosensitivity of Yoshida sarcoma solid tumors in comparison with the control. On the other hand the subcutaneous injections of glucose in the neighbourhood of tumors, 10 minutes before each irradiation causes a statistically significant inhibition of the tumours growth rate. At the end of fractionated irradiation, a complete regression of the sarcoma was observed, while in the control group the tumours were still persisting. The glucose alone, given intravenously does not exert any influence on the growth rate of tumours, while the subcutaneous injection of glucose as described above, inhibits their development during the initial period of treatment. The results thus obtained are considered to be due to the influence of increased concentration of oxygen during irradiation, arising in result of the Crabtree effect. (auth)

26279 INFLUENCE OF VITAMIN PREPARATIONS ON THE ACTIVITY OF SOME ENZYMES OF PROTEIN METABOLISM IN THE IRRADIATED ORGANISM. Savicki, I. V.; Savicki, V. I. (Odessa Medical Inst.). Radiobiol. Radiother.; 16: No. 5, 571-579(1975). (In German)

The eventual direction of compensation-repair processes in the irradiated organism utilizing shifts in dynamics and subcellular organization of integrating enzymes of nitrogen metabolism was examined: aspartate aminotransferase (GOT), alanine aminotransferase (GPT), glutamate dehydrogenase (GHD), and ornithine transcarbamylase (OCT) in the liver of rabbits once whole-body x-irradiated with a dose of 450 R; furthermore, the influence of the following injections on the activity of these enzymes was tested: of vitamin B_6, B_6 + ATP, B_1 + B_6 + FMN + PP + ATP. Radiation was shown to cause considerable changes in enzymatic activity in dependence on the subcellular organization of the enzymes and on the period after irradiation. During the first hours of the development of the effect after irradiation GOT-activity of hyaloplasm mainly increased, later on (1st to 5th day) that of mitochondria and towards the 30th day that of hyaloplasm again. The activity of all 4 enzymes increased during the first days after irradiation, from the 2nd week an increase in the activity of GOT, GPT, and GDH with decreasing OCT-activity could be observed. After irradiation GPT-activity was decreased for almost the whole time. Injections of preparations stimulated with the complication of the transaminases (especially GPT) and OCT. The administration of B_6 or of B_6 + ATP decreased GDH-activity and injection of preparation complexes increased it. The decrease of transaminase reactions between the 5th and 15th day after irradiation was not as high in treated rabbits than in untreated ones. (auth)

26280 STIMULATION OF THE IMMUNE RESPONSES OF TRYPANOSOMA INFECTED MICE UNDER THE INFLUENCE OF RADIATION CONSTITUTED BY MAGNETIC FIELD AND ELECTROMAGNETIC WAVES. Pautrizel, R.; Priore, A.; Mattern, P.; Pautrizel, A. N. (Univ., Bordeaux). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 16, 1915-1918(28 Apr 1975). (In French)

The remarkable efficiency of the physical treatment using such an association enables the mice to handle an infection otherwise lethal in a few days. The recovery is due to a very strong stimulation of the defense system of the host-animal particularly those related to the immune responses. This effect can be obtained in spite of the depression of the immunological defenses prior to the infection. The control of the infection by the mice is not due to direct action of the radiation on trypanosomes. (FR)

26281 EFFECT OF COMBINED RESORPTION PREPARATIONS CONTAINING PROSPIDIN AND ^{90}Y ON SOME STRAINS OF TUMOR. Dedenkov, A. N. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 21: No.1, 36-40(Jan 1976). (In Russian).

The authors give a characteristics of resorption antitumor preparations which contain prospidin and yttrium-90 and ensure a simultaneous supply of the source of ionizing irradiation and the chemo-therapeutic preparation directly to the tumor. It was shown that the efficacy of the action of these preparations on fibrosarcoma IMP-I and rhabdomyosarcoma exceeds the efficacy of each of antiblastomic agents taken separately. The article considers the advantages and disadvantages of chemo-radioactive resorption antitumoral preparations obtained on the basis of methyloxyprophilcellulose. (auth)

26282 RECONSTRUCTION OF MANDIBULAR DEFECTS AFTER RADIATION, USING A FREE, LIVING BONE, GRAFT TRANSFERRED BY MICROVASCULAR ANASTOMOSES. An Experimental Study. Ostrup, L. T. (Regional and Univ. Hospital, Linkoping, Sweden); Fredrickson, J. M. Plast. Reconstr. Surg.; 55: No. 5, 563-572(May 1975).

The replacement of a mandibular defect by a free, composite rib graft, transferred by microvascular anastomoses of the posterior intercostal vessels to donor vessels in the neck was described previously. We now present data which demonstrate that successful results can be achieved even after radical mandibular radiation. This technique, done in dogs, has obvious implications in the management of oral cancer in man. (auth)

26283 COLLAGEN CONTENT OF LUNGS OF MICE AFTER X-RAY IRRADIATION. Law, M. P.; Hornsey, S.; Field, S. B. (Hammersmith Hospital, London). Radiat. Res.; 65: No. 1, 60-70(Jan 1976).

To investigate the development of late radiation fibrosis in lungs large single doses of x rays were given to the hemithoraxes of mice. Hydroxyproline, an amino acid specific to collagen, was estimated in both irradiated and shielded lungs up to 48 weeks after exposure. There was a dose dependent atrophy of the irradiated lung and a compensatory hypertrophy of the shielded lung. The hydroxyproline per gram of dry irradiated lung increased between 24 and 36 weeks after 2000 to 4000 rad with no further change up to 48 weeks. Both total hydroxyproline content and dry weight of irradiated lungs decreased but after 24 weeks the histological appearance was that of collagen deposition after edema and hyperplasia. It is concluded that collagen deposition occurs at a late stage in the reorganization after radiation injury to mouse lung and is therefore probably not the cause of 80 to 180 day death after exposure of the whole thorax. (auth)

26284 EFFECTS OF LOW-LEVEL (1,0 R) X-IRRADIATION ON THE ERYTHROID RESPONSE OF THE RAT BONE MARROW. Gong, J. K.; Glomski, C. A.; Frederiksen, N. L.; Lawson, A. J.; Daley, J. p. (State Univ. of New York, Buffalo). Radiat. Res.; 65: No. 1, 83-97(Jan 1976).

The levels of normoblasts in the bone marrow of six groups of female Sprague–Dawley rats previously exposed to a 1,0 R dose of x rays were compared with those in sham-exposed animals at intervals from 14 hr to 10 weeks postirradiation. Four parameters were analyzed, the percentage of normoblasts in Wright's Giemsa stained marrow smears, and the number of erythroid precursors per milligram of isolated marrow sample, per whole femur, and per entire skeleton. The studies were based on marrow examinations and on ^{59}Fe tracer data. At all intervals except the earliest, [14 hr], significant elevations in the percentage of normoblasts were found in the bone marrow. In addition, at 6 and 10 weeks postirradiation increases were found in the number of normoblasts in the isolated marrow samples, whole femurs, and total skeletons. When compared 81 hr after phlebotomy, subnormal increases in normoblast levels were found in all four parameters of the irradiated subjects. The results suggest that x irradiation at this dose level can induce an abnormal marrow function manifested by an elevated number of normoblasts and, after phlebotomy, by a subnormal proliferation of the erythroid precursors. (auth)

26285 EFFECTS OF SUBLETHAL GAMMA RADIATION ON T AND B CELL ACTIVITY IN THE ANTIBODY RESPONSE OF MICE. Carlson, D. E.; Lubet, R. A. (Univ. of Texas Health Science Center, Dallas). Radiat. Res.; 65: No. 1, 111-119(Jan 1976).

The relative radiosensitivity of T and B cells was followed in sublethally irradiated mice reconstituted with bone marrow cells, thymus cells, or both, and simultaneously challenged with sheep erythrocytes. Numbers of antibody-forming cells in recipient spleens were determined on days 4 to 8. In this assay the response of mice given bone marrow cells was limited by the amount of residual T cell activity, while the response of mice given thymus cells was limited by the residual B cell activity. Although residual activity of both T and B cells was suppressed in mice given 300 to 700 rad at 80 rad/min, residual B cell activity was consistently lower in these animals. When antibody responses were initiated at intervals after irradiation, B cell activity was clearly limiting by 48 hr after 500 or 600 rad. The activity of both T and B cells was sensitive to differences in dose rate between 8 and 80 rad/min. The 4 to 7 fold dose-rate sensitivity of T cells paralleled that of differentially irradiated nonreconstituted mice. In contrast, dose-rate dependence of B cell activity varied from 10- to 20-fold between 8 and 80 rad/min. These results suggest that radiation suppression of antibody responses in mice is highly dependent upon B cell sensitivity, and that dose-rate dependence of the antibody response may be explained in large part by differential sensitivity of B cells. (auth)

26286 GENERATION OF CYTOTOXIC T LYMPHOCYTES IN VITRO. VII. Suppressive Effect of Irradiated MLC Cells on CTL Response. Fitch, F. W.; Engers, H. D.; Cerottini, J. C.; Bruner, K. T. (Swiss Inst. for Experimental Cancer Research, Lausanne). J. Immunol.; 116: No. 3, 716-723(Mar 1976).

Irradiated cells obtained from MLC at the peak of the CTL response caused profound suppression of generation of CTL when added in small numbers at the initiation of primary MLC prepared with normal spleen cells. The inhibitory activity of the MLC cells was not affected by irradiation (1000 rads) but was abolished by treatment with anti-theta serum and complement. The suppression was immunologically specific. The response of A (H-2/sup a/) spleen cells toward C3H (H-2/sup k/) alloantigens was suppressed by irradiated MLC cells obtained from MLC prepared with A spleen cells and irradiated C3H-stimulating cells, whereas the response of A spleen cells toward DBA/2 (H-2/sup d/) alloantigens was affected relatively little. However, if irradiated C3H x DBA/2F1 hybrid spleen cells were used to stimulate A spleen cells in MLC, addition of irradiated MLC cells having cytotoxic activity toward C3H antigens abolished the response to both C3H and DBA/2 antigens. The response to DBA/2 antigens was much less affected when a mixture of irradiated C3H and DBA/2 spleen cells was used as stimulating cells. Thus, the presence of MLC cells having cytotoxic activity toward one alloantigen abolished the response to another non-cross-reacting antigen only when both antigens were present on the same F1 hybrid-stimulating cells. This suppression of generation of CTL by irradiated MLC cells apparently involves inactivation of alloantigen-bearing stimulating cells as a result of residual cytotoxic activity of the irradiated MLC cells. This mechanism may be active during the decline in CTL activity noted in the normal immune response in vivo and in vitro. (auth)

26287 RADIATION CARCINOGENESIS. Laboratory Studies. Shellabarger, C. J. (Brookhaven National Lab., Upton, NY). Cancer, Suppl.; 37: No. 2, 1090-1096(Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

A brief review of animal studies following external radiation suggested the following generalizations. For low LET radiation several different dose-response relationships were obtained over a wide range of doses; lengthening the time over which the radiation is given generally lowers the risk of tumor induction. For high LET radiation the dose-response relationship usually appears to be linear and lengthening the time over which the radiation is spread does not lower the risk of tumor induction. No single RBE value for high LET radiation for tumor induction can be given but current studies point in the direction of an inverse relationship between RBE value and dose. Animal studies of radiation carcinogenesis provide information of more qualitative than quantitative significance in regard to human radiation carcinogenesis. (auth)

26288 EFFECTS OF ^{60}Co gamma-RADIATION ON THE HEPATIC AND CEREBRAL LEVELS OF SOME PROSTAGLANDINS. Pausescu, E.; Chirvasie, R.; Teodosiu, T.; Paun, C. (Fundeni Clinical Hospital, Bucharest). Radiat. Res.; 65: No. 1, 163-171(Jan 1976).

In two groups of rats irradiated with ^{60}Co gamma rays (500 and 750 rad, respectively) the changes in the hepatic and cerebral contents of prostaglandin E_1 and prostaglandin F/sub 2 alpha/ were investigated, at constant intervals, up to 18 days after irradiation. Hepatic and cerebral prostaglandins E_1 were found to be similarly increased during the whole postirradiation period in both 500-rad-irradiated rats and 750-rad-irradiated rats. Conversely, these rays were found to have no significant effect on the hepatic prostaglandin F/sub 2 alpha/ and to induce, depending on the radiation dose, a reversible or an irreversible decrease in the content of cerebral prostaglandin F/sub 2 alpha/. These results are believed to provide some evidence for a schematic formulation of a mechanism of the radiation-induced latent circulatory insufficiency and to elucidate some aspects of the functional interrelations between these prostaglandins, catecholamines, acetylcholine and cyclic AMP after gamma irradiation. (auth)

26289 INTRACELLULAR REPAIR AND CELL PROLIFERATION OF THE HAEMATOPOIETIC STEM CELL POOL OF GAMMA-IRRADIATED RATS AS DEMONSTRATED BY Fe-59 UPTAKE AND NUMBER OF NUCLEATED CELLS AFTER AN IRRADIATION-BLEEDING TREATMENT. Chang, C. M. Lawrence, KS; Univ. of Kansas (1975). 70p. University Microfilms Order No. 75, 26-368.

Thesis (Ph. D.).

In a group of three experiments, 159 female Sprague-Dawley rats were used to study the erythropoietic recovery after sublethal doses of ^{137}Cs gamma radiation. A bleeding technique was used in which one third of the calculated blood volume was removed from the rat through heart puncture at different times postirradiation in order to place a severe anemic stress on the animal. Immediately after bleeding, 2 Ci of ^{59}Fe was injected into each rat. Twelve hours after bleeding, rats were sacrificed and assayed for ^{59}Fe uptake and number of nucleated cells per femur to indicate the erythropoietic activities. The experimental results have permitted this author to reach the following conclusions. 1) The 12th hour after bleeding and ^{59}Fe injection is the optimum time for scoring. 2) There is evidence that by using this irradiation-bleeding technique, recovery of the stem cell pool from irradiation damage can be clearly demonstrated statistically. 3) There is a small yet statistically significant amount of intracellular repair in the sublethally damaged stem cells, and this type of repair is completed in less than one day. 4) From the 2nd day after irradiation, the stem cell pool starts to proliferate and the rate of proliferation is independent of radiation dose. 5) Cell proliferation plays a major role in the recovery of radiation damage to the stem cell pool. (Diss. Abstr. Int., B)

26290 PHYSIOLOGIC RESPONSES TO EXERCISE OF IRRADIATED AND NONIRRADIATED SHETLAND PONIES: A FIVE-YEAR STUDY. Brown, D. G. (Comparative Animal Research Lab., Oak Ridge, TN). Am. J. Vet. Res.; 36: No. 5, 645-652 (May 1975).

Physiologic responses of irradiated and nonirradiated Shetland ponies to controlled exercise were measured over a period of 5 years. The 5-year test began when the ponies were 3 years old and 5 months after they were exposed to 650 R of ^{60}Co gamma radiation. Significant differences in heart rates, respiratory rates, and rectal temperatures were demonstrated between irradiated and nonirradiated ponies when subjected to exercise and high ambient temperatures. In the irradiated group, heart rates were usually slower, especially during recovery immediately after exercise, and respiratory rates and rectal temperatures were higher than these rates were in the nonirradiated group when exercising in ambient temperature of 29.5 C. Exhaustive exercise did not amplify any of the differences which were apparent with moderate exercise. From a general viewpoint, the irradiated ponies performed work as efficiently as did the nonirradiated ponies. Early changes in blood-cell concentrations after irradiation were similar to those which have been observed in other large animal species. Time required for the various types of blood cells to return to base line values ranged between 3 months and 3 years. (auth)

Invertebrates

26291 (LBL-4702) EFFECTS OF WEIGHTLESSNESS, GRAVITY COMPENSATION AND RADIATION ON THE FLOUR BEETLE, TRIBOLIUM CONFUSUM. Yang, C. H.; Silver, I. L.; Tobias, C. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 70p. Dep. NTIS $5.50.

Tribolium confusum, the flour beetle; was chosen as a test organism for determination of possible synergistic effects of radiation and space environment in the inertial flight of Biosatellite-II. The organism subjected to weightlessness and radiation during the flight exhibited greater than expected wing abnormalities. However, a postflight vibration control experiment produced anomalous results, and some doubt remained with respect to assigning weightlessness as the sole cause of the increased wing abnormalities. Results are reported from experiments performed on the interaction of gravity compensation, radiation, and Tribolium development. It was found that gravity compensation together with heavy ion irradiation did not cause more wing abnormalities than those caused by radiation alone. However, radiation and gravity compensation plus high temperature did cause an increased percentage of wing abnormalities. Two possible reasons are discussed. (CH)

26292 RADIOPROTECTIVE EFFECTS AND TOXICITY OF DIMETHYL SULFOXIDE ON PANIRRADIATED ADULT MALES OF ANOPHELES MAC. ATROPARVUS (DIPTERA: NEMATOCERA). Lecis, A. R.; Orru, G. (Cagliari Univ., Italy). Riv. Biol.; 67: No. 3, 319-329(1974).

The data reported show that DMSO protects the sperm cells from the ionizing radiation at both the concentrations 0.5 and 2.0 M. The data were obtained measuring the hatching of the eggs laid by normal females crossed with treated males. This method is usually accepted when scoring dominant lethals mutations induced in sperms. The radioprotection exerted by DMSO on the whole animal has not been considered since it appears from earlier reports that a dose of 400 R is absolutely not sufficient to determine mortality among adult insect. (auth)

26293 STERILIZATION OF DACUS CUCUMIS FRENCH (DIPTERA: TEPHRITIDAE) BY γ RADIATION. I. Effect of Dose on Fertility, Survival and Competitiveness. Hooper, G. H. S. (Univ. of Queensland, St. Lucia, Australia). J. Aust. Entomol. Soc.; 14: 81-87(1975).

The effect of γ radiation administered to newly emerged adults of Dacus cucumis French on sterility and competitiveness was

evaluated. A dose of 11 krad caused almost complete sterility in males while females given 6 krad were totally sterile, through infecundity. Sterilized males showed reduced competitiveness. In competitive mating tests a dose of 7 krad gave the lowest egg hatch and this hatch was significantly lower than that given by 9 and 11 rad. In a paired comparison mating test, 7 and 9 krad treated males mated significantly less frequently than untreated males, but the ability of 6 krad treated males was unimpaired. (auth)

26294 POTENTIAL FOR CONTROL OF CADRA CAUTELLA (WALKER) BY RELEASE OF FULLY OR PARTIALLY STERILE MALES. Brower, J. H.; Tilton, E. W. (Agricultural Research Service, Savannah). Int. J. Appl. Radiat. Isot.; 26: No. 12, 720-725(1975).

Modifications of the sterile-male release technique appear to offer promise for the control of post-harvest lepidopteran pest populations within storage structures. Theoretical models of release strategies for Cadra cautella showed that each method has an "ideal" flooding ratio. This ratio represents the best balance between extinction in a few generations and minimization of the total number of insects released. From data reported concerning the population dynamics of Cadra cautella in the field an ideal flooding ratio for fully sterile (S) males to fertile (F) males of 97:1 would achieve extinction in 3 generations. The ratio of partially sterile males released in alternate generations that would achieve extinction in 4 generations was 125:1, and the ratio of partially sterile males released every generation that would achieve extinction in 5 generations was 74:1. Total numbers of males released per 100 native insects that would be needed to achieve extinction at these flooding ratios would be 14,850, 14,900 and 18,500, respectively. (auth)

26295 HYPERPLASIA AND ASSOCIATED RESPONSES OF THE VENTRICULUS FOLLOWING COBALT-60 GAMMA IRRADIATION OF PERIPLANETA AMERICANA (L.) (DICTYOPTERA: BLATTIDAE). Choban, R. G. New Brunswick, NJ; Rutgers-the State Univ. (1975). 95p. University Microfilms Order No. 75-24,673.

Thesis (Ph. D.).

American cockroach nymphs, 21-25 mm long, were maintained in a 16:8 (L:D) photoperiod; histological examination of midguts from non-irradiated individuals showed that the regenerative cells undergo a mitotic peak 2 hr after the start of the dark period. This peak and its later reduction represented a 2-hr lag when compared to the cycle of feeding activity for cockroach nymphs. Nymphs were irradiated with cobalt-60 gamma rays, and the LD_{50} 30 days after irradiation was approximately 8,000 rads. However, the dose of 4,500 rads was found to be most useful for producing the maximum observable histological effects while yielding a relatively low mortality. Food consumption was reduced following irradiation and the extent of the reduction was observed to be proportional to the dose delivered. Following irradiation with 4,500 rads, midguts progressed through a sequence that began with the suppression of mitosis for about 14 days. Beginning at this time, the mitotic rate increased greatly and mitotic overshoot resulted in the production of hyperplasia. Twenty-one days after irradiation, mitotic overshoot was 79 percent higher than controls, and hyperplasia reached a maximum. By 161 days after irradiation, surviving individuals returned to the appearance exhibited by control individuals. Mitotic abnormalities were also observed 7 to 21 days after irradiation. These include anaphase bridges, chromosome fragments, multipolar nuclei, giant cells, and multinucleated cells. This project has demonstrated that gamma irradiation is capable of producing hyperplasia in insect tissue and that similarities exist between insects and vertebrates with respect to mitotic abnormalities produced by gamma irradiation. These observations give support to the idea that research on invertebrates may be of value in vertebrate oncology. (Diss. Abstr. Int., B)

26296 ACUTE LETHALITY AFTER FAST-NEUTRON AND X IRRADIATION OF TRIBOLIUM CONFUSUM. Glenn, N. D.; Ducoff, H. S. (Univ. of Illinois, Urbana). Radiat. Res.; 65: No. 1, 120-129(Jan 1976).

The acute lethal effects of fast neutrons and of X-rays on adults and larvae of T. confusum are compared. The time course of mortality of adults of the Oklahoma strain was the same after midlethal doses of neutrons and X-rays, although the neutrons were about twice as effective as X-rays in producing lethality, based on LD/sub 50(35)/. The neutron RBE for adults of the Ebony mutant strain was also about 2, but that for Oklahoma larvae was about 3.85. Larvae surviving midlethal doses of neutrons showed a tendency toward wing abnormalities and delayed pupation. Dose-fractionation recovery with neutron doses in the midlethal range was not detectable in the adults or in the larvae. A considerable sparing effect of dose fractionation was found in X-irradiated adults. Also presented are techniques for using a beam port of a Triga research reactor for fast-neutron irradiation and a method of neutron and gamma dosimetry. (auth)

26297 TEMPERATURE-DEPENDENCE OF REPAIR OF SUBLETHAL RADIATION DAMAGE IN DROSOPHILA. Webb, J. V.; Hollingsworth, M. J.; Mill, A. J.; Davies, A. J. (St. Bartholomew's Hospital, London). Radiat. Res.; 65: No. 1, 187-190(Jan 1976).

Adult male Drosophila were irradiated with a total dose of 60 krad either as a single dose or in two equal fractions with a 24 hr interval spent at 3, 6.5, 10, or 25°C. There was a 14 percent increase in life span when the radiation-free interval was spent at 25°C, indicating the occurrence of repair. There was no increase in life span when the interval was spent at the lower temperatures. Repair is thus dependent upon temperature and presumably involves metabolically active processes in this predominantly postmitotic organism. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 26137, 26173, 26175, 26178, 26183, 26184, 26208, 26209, and 26225.

26298 (EUR-5397e, pp 73-82) COMPARISON OF GENERAL AND SPECIFIC DERIVED WORKING LIMITS FOR SURFACE CONTAMINATION WITH REFERENCE TO LOW TOXICITY ISOTOPES. Gibson, J. A. B. (Atomic Energy Research Establishment, Harwell, Eng.); Webb, G. A. M.; Wrixon, A. D. 1975.

From 2nd international conference on radiation protection-philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

It was shown that the skin and surface DWL's for certain nuclides can be relaxed by factors up to 10^2 compared with the DWL for ^{90}Sr. Although it is possible to provide specific DWL's for individual isotopes it is suggested that two extra groups could be used with relaxations of 10 and 10^2 compared with the skin DWL for ^{90}Sr of 1 μCi m^{-2} (10^{-4} μCi cm^{-2}). The half life of the nuclides and impurities have been taken into account in placing the individual nuclides in the appropriate group. The list is not considered to be exhaustive and is only presented as a basis for discussion. However, if such a scheme is adopted then monitoring of the environment in hospitals, universities and factories should be greatly simplified with a saving in equipment and labor costs. (auth)

26299 (EUR-5397e, pp 83-94) INTERPRETATION OF CARBON-14 EXCRETION DATA IN TERMS OF ABSORBED DOSE. Dancer, G. H. C.; Finnigan, T. (Radiochemical Center, Amersham, Eng.). 1975.

From 2nd international conference on radiation protection-philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Organic compounds labelled with carbon-14, often at very high molar specific activity (near 100% isotopic abundance) have been prepared in multi-millicurie quantities at the Radiochemical Center for many years. Environmental sampling has always indicated that intakes of carbon-14 by the operating staff should be extremely small. Measurements of carbon-14 excretion rates in breath and urine have also been made over many years without showing any significant trends. The metabolic data required to relate observed excretion rates to absorbed doses is available for only a limited number of compounds and even this data is not necessarily applicable to the intake of materials of high specific activity. In order to determine whether whole body doses received by staff handling these compounds were significant in relation to statutory dose limits a number of operators were studied in detail. The data from the operator showing the highest excretion rates during this investigation were interpreted by the use of a number of simple models which provided estimates of the annual whole body dose attributable to the carbon-14 intakes. (auth)

26300 (EUR-5397e, pp 201-206) APPLICATION OF ICRP RECOMMENDATIONS TO THE CONTROL OF RADIOACTIVE WASTES. Kenny, A. W. (Department of the Environment, London). 1975.

From 2nd international conference on radiation protection-philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

There are three general methods for the disposal of wastes: to store them, usually after preliminary concentration; to disperse them in the environment, usually after preliminary dilution; and to treat them in order to transform them into products which either may not be waste or may then be contained or dispersed. The management of the disposal of wastes in any given case is the proper choice between these methods. The last method is of only limited value for radioactive wastes since the nuclear changes which cause the radiations which result in the physical processes in human tissues which lead to the deleterious biological effects are quite unaffected by any conceivably economic treatment. Of the other two methods, the ICRP recommendations determine whether dispersal may be used but have practically no application to the conditions of storage. The considerations affecting the storing of radioactive wastes and in what physical form they should be stored are dominated by the physical risks of the storage. If these risks can be made vanishingly small, there will be no environmental effect; and if they cannot, the considerations which apply are those relating to accident, for which the ICRP recommendations are not apt. The recommendations apply in principle only to the planned controlled release of radioactive wastes to the environment, though it may be legitimate to enquire further about occupational exposure if environmental considerations should demand treatment or special handling of the waste. (auth)

26301 (EUR-5397e, pp 258-267) ROLE OF MEASUREMENT IN THE ASSESSMENT OF THIRD PARTY LIABILITY FOLLOWING AN ACCIDENTAL RELEASE OF PLUTONIUM TO THE PUBLIC ENVIRONMENT. Duchene, A. (CEA, Paris); Jacquemin, M.; Emmerson, B. W.; Handyside, I. 1975.

From 2nd international conference on radiation protection--philosophy and implementation; Aviemore, Scotland, United Kingdom of Great Britain and Northern Ireland (UK) (2 Jun 1974).

In radiation protection measurement: philosophy and implementation.

Some topics discussed are: third party liability in the field of nuclear energy; relating quantity to potential third party damage; nature of materials released; release conditions; radiobiological effects on persons exposed; cost of meeting claims from damage to persons; liability resulting from loss of, or exclusion from contaminated property; and problems of measurement at acceptable levels of residual contamination. (HLW)

26302 (NP-20815) CANCER HAZARD FROM INHALED PLUTONIUM. Gofman, J. W. (Committee for Nuclear Responsibility, Dublin, Calif. (USA)). 14 May 1975. 27p.

The best estimate of the lung cancer potential in humans for inhaled insoluble compounds of plutonium (such as PuO_2 particles) has been grossly underestimated by such authoritative bodies as the International Commission on Radiological Protection and the British Medical Research Council. Calculations are presented of lung cancer induction by ^{239}Pu as insoluble particles and for deposited reactor-grade Pu. The reason for the gross underestimate of the carcinogenic effects of Pu by ICRP or the British Medical Research Council (BMRC) is their use of a totally unrealistic idealized model for the clearance of deposited Pu from the lungs and bronchi plus their non-recognition of the bronchi as the true site for most human lung cancers. The erroneous model used by such organizations also fails totally to take into account the effect of cigarette-smoking upon the physiological function of human lungs. Plutonium nuclides, such as ^{239}Pu, or other alpha particle-emitting nuclides, in an insoluble form represent an inhalation cancer hazard in a class some 100,000 times more potent than the potent chemical carcinogens, weight for weight. The already-existing lung cancer data for beagle dogs inhaling insoluble PuO_2 particles is clearly in order of magnitude agreement with calculations for humans. (CH)

26303 (UCRL-Trans-10999) STUDY ON THE USE OF PROTACTINIUM 233 AS A SIMULATOR OF PLUTONIUM 239 IN PULMONARY DOSIMETRY. Nikpay-Aslie, P. Translated from Radioprotection; 9: No. 3, 205-210(1974). 10p. Dep. NTIS $3.50.

For the measurement of pulmonary charges induced by ^{239}Pu, an emitter of x-rays of very low energies, a method has been suggested consisting of administering an aerosol of ^{233}Pa. In effect, the ^{233}Pa with a short decay period, emits in addition to the same x-rays a photon gamma of 310 keV, allowing the measurement of the administered radioactivity. For the measurement of low energies, the efficiency of a scintillation detector and proportional counter were compared by means of measurement made on an antropomorphous tissue equivalent phantom. The proportional counter permits the measurement of the x rays and confirms the use of ^{233}Pa as a simulator of ^{239}Pu. (auth)

26304 RADIATION FROM RADIUM NEEDLES. Aten, A. H. W. (Univ., Amsterdam). Int. J. Appl. Radiat. Isot.; 26: No. 11, 694-695(Nov 1975).

Recently it was pointed out that about 20% of the β rays of RaC (^{241}Bi) have a maximum energy of 3.18 MeV which means that their maximum range exceeds the normal wall thickness of a radium needle, i.e. 0.5 mm platinum. To evaluate the contribution these β rays made to the absorbed dose in tissue, absorption curves have been measured of the radiation emitted by low-activity radium needles with a 0.5 mm platinum wall. G-M counters, which have a high sensitivity for electrons and a low sensitivity for photons, were used. As absorbers aluminium or lead foils were placed between the needle and the counter and different geometries were adopted. Such absorption curves are shown and interpreted. It is concluded that there is a contribution from a low penetration component to the absorbed dose in the first one or two millimeters of tissue around a radium needle, but that this component cannot be noticeably reduced by increasing the thickness of the platinum wall. (UK)

26305 MICRODISTRIBUTION OF THE ABSORBED ENERGY OF ALPHA-EMITTING ISOTOPES INCORPORATED IN HUMAN LUNGS. Belonogii, P. N.; Ivanov, V. I.; Makeeva, L. G.; Makmakov, B. V.; Pavlovskaya, N. A. pp 17-20 of Voprosy mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124--.

The microdistribution of the absorbed energy of alpha-emitting isotopes is calculated for the case of chronic accumulation of dusts in the lungs of a man exposed professionally during 48 weeks per year for a 36-hr work week. It is assumed that in the work area there are dusts containing ^{232}Th in equilibrium with its decay products. The dependence of the function for the deposition of the dusts in the lungs on the particle dimensions is shown. The values obtained for the microdistribution are shown graphically. (JSR)

26306 DETERMINATION OF THE PENETRATION OF DECAY PRODUCTS OF RADON INTO THE RESPIRATORY ORGANS BY A DIRECT METHOD. Ruzer, L. S. Sov. At. Energy (Engl. Transl.); 38: No. 4, 331-333(Apr 1975).

Translated from At. Energ.; 38: No. 4, 260-261(Apr 1975).

The determination of the absorbed doses of internal irradiation of the lungs of mine workers in the case of inhalation of short-lived decay products of radon is an urgent problem. Up to the present time it has been solved by measuring the concentrations of isotopes at the work sites and computing the absorbed dose according to set rates of inhalation and the coefficients of retention of aerosols in the respiratory organs. But the value of the retention coefficient depends on the physicochemical properties of the aerosols and cannot be measured with sufficient accuracy. The value of the rate of inhalation also is rather indefinite, since it depends on the physical load (the nature of the work) and varies within broad limits. The question of the treatment of the value of the measured concentration is extremely important. The concentration of isotopes in air at the same place is subject to substantial variations. For example, a variation of the intensity of ventilation even for a short period of time leads to a change in the radon concentration of severalfold. Moreover, the content of isotopes directly in the zone of respiration of the miners may differ substantially from the value measured by the usual instruments. Finally, the very concepts of work place and concentration at the work place are indefinite, since miners are at several work places during their work shift, with variable concentrations of decay products of radon in the mine atmosphere. (auth)

26307 ASSOCIATION BETWEEN SYSTEMICALLY ADMINISTERED RADIOISOTOPES AND SUBSEQUENT MALIGNANT DISEASE. Berlin, N. I.; Wasserman, L. R. (Northwestern Univ., Chicago). Cancer, Suppl.; 37: No. 2, 1097-1101(Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

There is a long history recording the association of x radiation and the subsequent development of malignant tumors. For systemically administered isotopes this came into prominence when Martland discovered the association between cancer, particularly of the bone, and ingestion of radioactive isotopes by radium dial painters. This association was amplified by the development of cancer in patients given thorotrast as a contrast medium for diagnostic radiologic examination. Acute leukemia was reported 30 years ago in patients with polycythemia vera treated with ^{32}P. Acute leukemia also occurs in patients with polycythemia vera treated only with phlebotomy or drugs. A controlled study is now underway to provide a more definite answer to question what is the incidence of acute leukemia in patients with polycythemia vera treated by phlebotomy alone, chlorambucil, or ^{32}P, ^{131}I for the

treatment of hyperthyroidism probably does not induce cancer, but in the doses used for thyroid cancer there was an increased incidence of neoplasms (12/200 in one study). This was higher than the expected incidence of neoplasms. The doses of radioactive isotopes used currently for diagnostic purposes have not induced cancer, but it is difficult and probably impossible to verify this with absolute certainty. (auth)

Animals

26308 SINGULARITIES OF THE MICRODISTRIBUTION OF THORIUM IN THE LUNGS OF RATS AFTER THE INTRATRACHEAL INTRODUCTION OF ITS COMPOUNDS. Pavlovskaya, N. A.; Makeeva, L. G. pp 81-82 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian)

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

Experimental studies on the microdistribution of Th in the lungs of rats showed that the type and character of microdistribution was determined by the chemical composition of the Th compound, its concentration, and the time interval after its introduction. The two compounds tested with $ThCl_4$ and ThO_2. The singularities of the Th microdistribution determined both the distribution of the absorbed dose and the radiotoxic effects of the Th. (JSR)

26309 PREVENTION OF RADIATION PNEUMONITIS FROM INHALED ^{144}Ce BY LUNG LAVAGE IN BEAGLE DOGS. Muggenburg, B. A.; Mauderly, J. L.; Boecker, B. B.; Hahn, F. F.; McClellan, R. O. (Inhalation Toxicology Research Inst., Albuquerque, NM). Am. Rev. Respir. Dis.; 111: No. 6, 795-802(Jun 1975).

This study was performed to evaluate bronchopulmonary lavage and chelation therapy as a treatment method to prevent the development of radiation pneumonitis after inhalation of a radioactive aerosol. Twelve beagle dogs were exposed to an aerosol of cerium-144 in fused clay particles resulting in initial lung burdens from 47 to 64 mu Ci of ^{144}Ce per kg of body weight. Eight of the dogs were treated with a series of 10 bronchopulmonary lavages and 10 intravenous injections of calcium diethylenetriamine pentaacetate acid during the first 56 days after exposure to remove the deposited ^{144}Ce; the remaining 4 exposed dogs received no treatment. An additional 4 dogs were exposed to stable cerium and were given the course of treatment as an additional control group. Three of the 4 untreated dogs and 2 of the 8 treated dogs died 171 to 246 days after exposure with radiation pneumonitis or pulmonary fibrosis, or both. All but one of the remaining dogs were alive and apparently in good clinical health 550 days after exposure; the one dog had radiographic indications of pulmonary fibrosis by 365 days after exposure. The relative distribution of ^{144}Ce in the lungs and other major organs was similar in the treated and untreated dogs that died. (auth)

26310 MORPHOLOGICAL AND BIOCHEMICAL BLOOD CHANGES IN COWS CHRONICALLY EXPOSED TO STRONTIUM-90. Sirotkin, A. N.; Sarapultsev, I. A.; Rudskikh, T. A.; Bogatov, L. V. (Inst. of Biophysics, Moscow). Zh. Obshch. Biol.; 36: No. 6, 935-941(1975). (In Russian).

Morphological and biochemical blood changes were studied in nine cows 9 to 10 years of age that had been chronically administered ^{90}Sr with the diet. It was found that at daily ^{90}Sr doses of 0.02 and 0.2 μCi per kg of body weight given for 8 years (the absorbed marrow doses from 930 to 3450 rads, respectively) no changes in the red blood cells, hemoglobin, platelet, and white blood cell counts, as well as in the hematocrit and ESR test, were observed. However, there was a change in cell quality which was partly responsible for a decrease in relative and absolute number of mature neutrophils in the peripheral blood after the accumulated dose had reached 3000 rads. It should be noted that the qualitative blood cell tests, such as the determination of the number of white blood cells with degenerative changes or the acid-erythrogram, were more radiosensitive than the quantitative ones. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstract 26306.

26311 (CEA-CONF-3153) BIOLOGICAL BEHAVIOR OF PLUTONIUM 239. Lafuma, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 12p. (In French). INIS.

A review is made of the biological behavior of plutonium-239 in man and the environment, the diagnosis and treatment of contaminations, plutonium toxicity and safety standards. (FR)

26312 (CONF-741182-, pp 102-119) SKIN DECONTAMINATION. Moehrle, G. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). 1974.

From scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations; Brussels, Belgium (28 Nov 1974).

In scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations. (Commission of the European Communities, Brussels (Belgium)).

In calculating the internationally accepted maximum permissible values for surface contamination of the skin, allowance was made for the fact that the whole epidermis is renewed in three to four weeks. Furthermore, a skin diffusion of approximately 10% of the contamination was assumed as starting point. The values generally applicable for a maximum permissible α-contamination are 10^{-5} $\mu Ci/cm^2$ and for β-contamination 10^{-4} $\mu Ci/cm^2$. These values relate only to localized contamination. In principle, all measurable activity, i.e., a pulse count which registers above zero on a sensitive monitor, should be regarded as contamination which must be eliminated. The intensity of decontamination measures, however, depends largely on the extent of the contamination. It is virtually impossible to define when decontamination should be carried out by the contaminated person himself, and this should be done by radiation protection workers or supervised by the doctor. Previous experience shows that it is most frequently the unclothed parts of the body, i.e., hands, hair and face, which become contaminated. Shower equipment is highly unsuitable for these types of partial contamination, since it must be expected that localised activity will be distributed over the whole-body. Wash basins which are wider and in particular deeper than normal ones, with mixer tops to provide 30 to 32°C water, are much more suitable for the parts of the body where local contamination is most frequent. Repeated washing and the use of decontaminating agents may be required. The effectiveness of various decontaminating agents is discussed. (CH)

26313 (CONF-741182-, pp 120-123) PULMONARY LAVAGE. Lafuma, J. (CEA, Fontenay-aux-Roses, France). 1974.

From scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations; Brussels, Belgium (28 Nov 1974).

In scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations. (Commission of the European Communities, Brussels (Belgium)).

Several experimental studies have been carried out to remove insoluble radioactive particles from lungs in which they had settled. The only method which has proved effective up to the present is pulmonary lavage, generally carried out with a physiological solution of sodium chloride. Research carried out on dogs, rats, and baboons showed approximately 50% of the particles in the lungs were removed by this method. Only one human contaminated with plutonium-239 oxide has been treated by this method, which enabled a fraction of the contaminant to be removed. A method of pulmonary lavage is described. (auth)

26314 (CONF-741182-, pp 124-172) TRITIUM CONTAMINATION AND EXTRARENAL CLEARANCE. Henry, P. (C.E.A., Begnoli-sur-Ceze, France). 1974.

From scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations; Brussels, Belgium (28 Nov 1974).

In scientific colloquium on medical supervision of workers exposed to ionizing and nonionizing radiations. (Commission of the European Communities, Brussels (Belgium)).

In cases of significant internal contamination of personnel by tritium, a therapy aimed at accelerating the turnover rate of tritium in the body should be applied. A study was made to determine the effectiveness of extrarenal clearance methods in hastening the elimination of tritiated water. The results show that the biological half life in man can be reduced to 13 hours by peritoneal dialysis, consisting of injecting approximately two liters of isotonic or hypertonic fluid into the peritoneal cavity, and to less than 4 hours by hemodialysis, using an artificial kidney machine. The type of treatment and its duration should be based on the calculation of the dose commitment; in practice, this can probably be reduced to 5% of the initial concentration. (CH)

26315 (ORNL/TM-5257) REVIEW OF JOHN W. GOFMAN'S REPORTS ON HEALTH HAZARDS FROM INHALED PLUTONIUM. Richmond, C. R. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 24p. Dep. NTIS $5.00.

This document is a review of two reports prepared in 1975 by John W. Gofman on the subject of plutonium toxicity. Because Gofman's estimates of the calculated health effects from inhaled plutonium are significantly higher than those obtained from other analyses (including the risk estimates calculated by the National

Academy of Science's Advisory Committee on the Biological Effects of Ionizing Radiation), it was decided to critically review Gofman's papers and supporting arguments. This review concludes that Gofman's predictions of large numbers of plutonium-induced lung cancers from nuclear weapons testing are derived mainly from his incorrect assumptions about the effects of cigarette smoking on the retention of plutonium particulates in the tracheobronchial region of the lungs. It appears that Gofman's assumptions are considerably overstated and cannot be substantiated by currently available information. Also, Gofman's attempt to equate a given number of lung cancer deaths to a pound of plutonium tends to obfuscate rather than clarify attempts to derive risk estimates for inhaled plutonium. (auth)

26316 CESIUM-134 IN HUMAN AUTOPSY TISSUE. Ide, H. M.; McInroy, J. F. (Los Alamos Scientific Lab., NM). Health Phys.; 29: No. 6, 871-872(Dec 1975).

During examination of human autopsy tissue by gamma counting, carried out since 1971, ^{134}Cs has been identified in 42 out of 621 sets of tissue investigated. Plans are underway to obtain complete medical, occupation, and residence histories on each of these cases to identify the source of this activity. However 14 of the 16 cases whose medical histories are known have been identified as having received /sup 99m/Tc for scanning purposes. It has been shown by previous workers that ^{134}Cs is a contaminant on the columns and in the eluates of some commercial /sup 99m/Tc generators. Reported contaminations by ^{134}Cs of various aspects of the environment are listed. It is stressed that due to the widespread use of /sup 99m/Tc in medical scanning procedures, the appearance of ^{134}Cs in human tissue due to the contamination of the generators should be of interest to those radiologists making dose calculations. (UK)

26317 BONE UPTAKE OF RARE EARTHS AND TRANSURANIC ELEMENTS. Masse, R.; Metivier, H. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France). Section de Pathologie et de Toxicologie Experimentales); Guillaumont, R. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). pp 441-450 of Physico-Chemistry and Crystallography of Apatites of Biological Interest. Paris, France; Centre National de la Recherche Scientifique (1975). (In French)

From international colloquium on physico-chemistry and crystallography of apatites of biological interest; Paris, France (10 Sep 1973).

In the first part of this paper formation conditions of citric complexes of rare earths and transuranic elements are presented. In the second part, role of binding proteins in plasma is emphasized. Finally biological behavior of the injected elements is evidenced. A general mechanism for fixation of these elements in bone and liver is proposed. (FR)

26318 PHARMACO-KINETICS OF CURRENT SKELETAL-SEEKING RADIOPHARMACEUTICALS. Krishnamurthy, G. T.; Huebotter, R. J.; Tubis, M.; Blahd, W. H. (VA Wadsworth Hospital Center, Los Angeles). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 126: No. 2, 293-301(Feb 1976).

The blood clearance of all current bone-seeking radiopharmaceuticals is biexponential during the first four hours after injection. Exponent I represents bone uptake and its clearance half-time is less than 30 min. Exponent II represents mainly urinary excretion and its clearance half-time varies from 168 to 512 min. The blood background is highest with /sup 99m/Tc-labeled polyphosphate (Tc-Poly) and lowest with sodium fluoride (F-18); /sup 99m/Tc-labeled diphosphonate (Tc-Dip) and /sup 99m/Tc-labeled pyrophosphate (Tc-Pyro) show intermediate blood levels. The slower blood clearance of /sup 99m/Tc-phosphate complexes in comparison with F-18 is due primarily to their increased protein binding. Tc-Poly blood clearance, which is slower than that of Tc-Dip and Tc-Pyro, is due primarily to its increased red cell binding and the larger size of its molecule. Bone uptake and urinary excretion of all /sup 99m/Tc-labeled phosphate complexes are approximately the same; in the range of six to ten percent in the blood, 30 to 33 percent in the urine, and 55 to 58 percent in the bone and other tissues. F-18 concentration in the bone is almost 1.5 times that of the /sup 99m/Tc-labeled phosphate complexes. The sensitivity and resolution of lesions are identical for all /sup 99m/Tc-labeled phosphate complexes and are far better than those for F-18. No toxicity is noted with the amount of phosphate present in the marketed kits, and it appears reasonable to use the minimal amount so long as efficiency is not compromised. (auth)

26319 PULMONARY DISTRIBUTION OF AN INHALED RADIOAEROSOL IN OBSTRUCTIVE PULMONARY DISEASE. Lin, M. S.; Goodwin, D. A. (Veterans Administration Hospital, Palo Alto, CA). Radiology; 118: No. 3, 645-651(Mar 1976).

Pulmonary distribution of an inhaled radioaerosol was analyzed in 20 cases of chronic obstructive pulmonary disease (COPD) and 8 of other OPD. Nonciliary/ciliary partition of the distribution correlated with the severity of airway obstruction and approximated 3:1 in mild and 1:3 in very severe obstruction. In nuclear images, the distribution featured contrast abnormalities of hyperdeposition and hypodeposition. Intense hyperdeposition most commonly occurred in hilar and perihilar large airways. In isolated instances, hyperdeposition almost certainly occurred focally at sites of partial bronchial obstruction and diffusely by expiratory trapping; hypodeposition occurred distally to bronchial obstruction and in areas of parenchymal loss. (auth)

Animals

26320 ISOTOPIC DILUTION OF ZINC-65 IN OREGON COASTAL WATERS. Cutshall, N. H.; Renfro, W. C.; Larsen, I. L. (Oregon State Univ., Corvallis). Health Phys.; 29: No. 6, 865-869(Dec 1975).

Specific activity of ^{65}Z ($^{65}Zn/Zn$) observed in mussels, Mytilus californianus, collected along the Oregon coast is compared to values predicted, based on a simple model for isotopic dilution of ^{65}Zn in the Columbia River. The observed values are very similar to those computed from the model. The analysis provides no evidence that chemical speciation of zinc in coastal waters affects the specific activity of mussels. (auth)

26321 RADIOIODINE ^{131}I IN ANIMAL THYROIDS DURING NUCLEAR TEST IN BOTH HEMISPHERES. Van Middlesworth, L. (Univ. of Tennessee, Memphis). Health Phys.; 29: No. 6, 861-863 (Dec 1975).

In mid-1974 a small increase of ^{131}I was observed in animal thyroids following a nuclear test in China. In late 1974 there was no public announcement of an atmospheric nuclear test in the Northern Hemisphere, but ^{131}I was readily measured in animal thyroids. This latter increase occurred while animals in the Southern Hemisphere accumulated ^{131}I from nuclear tests in the Southern Hemisphere. It is suggested that in late 1974 the Northern Hemisphere was contaminated by either late fallout from tests in June or by interhemispheric mixing or by a combination of these sources. (auth)

26322 EARLY PHASES OF METABOLISM OF ORALLY ADMINISTERED STRONTIUM-90. Nechev, Kh. Letopisi Khig.-Epidemiol. Sluzhba; 8: No. 43, 56-60(1974).

The coefficient of strontium-90 absorption by the gastrointestinal tract was studied and the early phases of its metabolism followed up. An experiment was carried out on 30 two-month old, sexually mature rats which received a single oral radionuclide dose in the form of $SrCl_2$-0.2 ml. 7.4 mcc activity. Results: 1) In the early period an appreciable part of the orally administered strontium-90 was deposited in the bone (within the first 24 hours as much as 38 percent of the total administered amount). 2) In the early phases the period of strontium-90 semi-elimination from bone tissue amounted to 20.4 days, from the liver - 3 days, from muscle tissue - 2.8 days. 3) The radionuclide absorption coefficient tested by using a personal modification of a known formula was unaffected by the site of strontium-90 administration into the vascular system and was equal to 0.46. The rather high absorption and deposition coefficients were obviously due to the fact that the experiment was promoted on young animals. (Abstr. Bulg. Sci. Med. Lit.)

26323 PHYSICOCHEMICAL STATUS OF CERIUM-144 IN RAT BLOOD PLASMA AND TISSUES. Nechev, Kh.; Fedorova, A. Leptopisi Khig.-Epidemiol. Sluzhba; 8: No. 42, 165-170(1974). (In Russian).

A study of the physico-chemical status of cerium-144 in the blood plasma, liver, kidneys, and bones of 24 sexually mature rats showed that cerium-144 is almost wholly bound to plasma and tissue proteins. In the blood plasma, liver, and kidneys the radioisotope is largely bound to the globulins and in the bones to the collagen. (Abstr. Bulg. Sci. Med. Lit.)

26324 PHYSICOCHEMICAL STATUS OF STRONTIUM-90 IN RAT BLOOD PLASMA AND TISSUES. Necev, H.; Fedorova, A. Letopisi Khig.-Epidemiol. Sluzhba; 8: No. 42, 170-175(1974). (In Russian).

A study of the chemico-physical status of strontium-90 in the blood plasma, bones, liver, and kidneys of 24 sexually mature rats demonstrated that in the blood plasma and parenchymal organs strontium-90 is bound to the albumin fraction and in the bones to the inorganic fraction. (Abstr. Bulg. Sci. Med. Lit.)

26325 ISKUSSTVENNYE RADIONUKLIDY V MORSKOI SREDE. (Artificial Radionuclides in Marine Media). Gromov, V. V.; Spitsyn, V. I. Moscow; Atomizdat (1975). 224p.

The effect of different factors on the physical-chemical state of nuclear fuel fission products in marine media is analyzed.

Special attention is given to processes connected with the activity of phytoplankton, one of the basic hydrobionts of the oceans of the world. The uptake of fission products by suspensions and bottom deposits is examined. Some methodical questions on the study of the physical-chemical state of microelements in a marine environment are analyzed. (tr-auth)

26326 FUNCTION OF ALGINIC ACID ON THE RADIOACTIVE CONTAMINATION OF SOME MARINE INVERTEBRATES DEPOSITE-FEEDERS. Amiard-Triquet, C. (Centre de Recherches du Service de Sante des Armees, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); Nantes Univ., 44 (France)). Cah. Biol. Mar.; 16: 1-5(1975). (In French).

The contamination of invertebrates by radionuclides in a sedimentary environment is a function of the mobility of radioactive ions and especially of the mode of sorption of the radionuclides on the sediment and the ion retention by the algines. Since the enzymatic system of species feeding on the sediment includes little or no alginase, there occurs no desorption of the radionuclides during the passage of the algines along the digestive tract. (FR)

26327 APPLICATION OF FACTORIAL ANALYSIS TO AN EXPERIMENTAL STUDY OF RADIOSTRONTIUM METABOLISM IN THE PLAICE (PLEURONECTES PLATESSA). Amiard, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection; Paris-6 Univ., 75 (France)). Rev. Int. Oceanogr. Med.; 39-40: 177-212(1975). (In French)

The use of factorial analysis techniques (principal components and correspondences) allowed to interpret several experiments on strontium metabolism in the plaice and its variations as a function of several biotic (age) and abiotic factors (temperature, salinity, sediment, calcium concentration of waters). Strontium uptake occurred mainly in soft tissues during the earliest contamination stage, whereas after the 12th day, it occurred mainly in the hard tissues. Colder temperature, the passage from brackish to sea-water, from gravel to sand, lowered strontium uptake. Within the experimental limits, calcium concentration had no effect on strontium uptake. (FR)

26328 A CONTRIBUTION TO THE STUDY OF STRONTIUM AND CALCIUM METABOLISM IN TWO MARINE TELEOST SPECIES: MULLET (MUGIL AURATUS RISSO) AND PLAICE (PLEURONECTES PLATESSA L.). Amiard, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Union Oceanograph. Fr.; 5: No. 3, 1-6(Sep 1973). (In French)

Following a summary of the technical procedures, the results obtained on the kinetics and distribution of radiostrontium in teleosts are given. The effect of physico-chemical parameters (salinity, temperature, ionic concentration, sediments,...) on the retention of ^{85}Sr is then considered, and the distribution of strontium and calcium in the acellular bone tissues of the Mullet was studied using autohistoradiographic techniques. (FR)

Plants

Refer also to abstracts 26009 and 26346.

26329 SOME OBSERVATIONS ON POTASSIUM, RUBIDIUM-86, AND CAESIUM-137 ABSORPTION BY PLANTS GROWN ON NUTRITIVE SOLUTIONS. Souty, N.; Guennelon, R.; Rode, C. (Institut National de Recherches Agronomiques (INRA), 84-Avignon (France). Centre de Recherches Agronomiques de Sud-Est). Ann. Agron.; 26: No. 1, 41-58(1975). (In French)

The absorption and distribution of rubidium-86, caesium-137 and potassium in the various organs of four plants grown on nutritive solutions was followed; their behavior was compared. Within the limits of this research, neither ^{86}Rb nor ^{137}Cs can be considered as quantitative tracers of K. In addition, from these results, the problem of radio-protection was approached. (FR)

26330 NUCLEAR METHODS FOR DETECTING ROOT ACTIVITY. Haahr, V. (Danish Atomic Research Commission, Risoe). pp 57-63 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

Two nuclear methods for evaluating root activity were compared in a field experiment with equally spaced plants of two spring barley genotypes. The ^{32}P and water uptake from different depths were used to evaluate the root activity. The uptake of ^{32}P from a given depth varied considerably more from plant to plant than the dry matter production. It is concluded that the ^{32}P technique is not suitable for selection of single plants of genotypes differing in root activity. Measurements of water uptake from soil profiles with a neutron moisture meter are found to be a useful technique for detection of root activity of plant stands. (auth)

New Tracer Techniques

Refer also to abstracts 26029, 26034, 26036, and 26319.

26331 (AED-CONF-75-141-020) WHOLE-BODY COUNTER INVESTIGATIONS ON THE ABSORPTION OF CALCIUM. Kunkel, R.; Leicht, G. (Universitaet des Saarlandes, Homburg/Saar (F. R. Germany). Medizinische Fakultaet). 1975. 7p. (In German). INIS.

From 6th scientific meeting of the Deutsche Gesellschaft fuer Medizinische Physik; Berlin, F. R. Germany (28 Apr 1975).

5 refs.

The results of classical balance investigations show that in various disturbances of the calcium metabolism in humans, a certain diagnostic significance may be assigned to the resorption of the calcium. These classical balance investigations as well as later tests with radioactive calcium isotopes require the quantitative collection of faeces and urine. As is known, this often, however, involves relatively large technical and organizational problems. It is thus advantageous to determine the calcium resorption by a whole-body measurement where these disadvantages no longer arise. (DE)

26332 (CEA-CR-3, pp 108-111) QUALITATIVE AND QUANTITATIVE DYNAMIC EXPLORATIONS OF THE TRANSPLANTED KIDNEY USING THE γ-CAMERA: PROGNOSTIC VALUE OF THE RESULTS. Piret, L.; van der Linden, S.; Beckers, C.; Otte, J. B.; van Ypersele, C.; Alexandre, G. 1975. (In French)

From 17th French language symposium on nuclear medicine; Paris, France (2 Jun 1975).

In 17th French language symposium on nuclear medicine. Paris, June 2-4, 1975. Reports and communications. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept.

The results obtained in kidney transplant patients after perfusion studies and determination of hippuran concentration and excretion by the graft are reported on the one hand, and on the other an attempt is made to establish the value of qualitative and quantitative results in forecasting the later development of the transplant. The kidney perfusion was studied on scintiphotographic sequences taken by a scintillation camera every 4 seconds after intravenous injection of a 10 mCi shot of $^{99m}TcO_4^-$. The appearance of ^{131}I hippuran and its migration towards the pyelo-calicial cavities and the bladder were estimated on scintiphotographs taken every minute after intravenous injection of a 500 μCi dose. The study involved 115 transplant patients. When the graft shows a total absence of ^{99m}Tc perfusion combined with a very low hippuran concentration its rejection can be diagnosed. A study of the later progress of these patients has shown the prognostic value of this absence of perfusion. The prognosis is bad when the maximum fixation of hippuran during the first 6 minutes is less than 2%. (FR)

26333 (CEA-CR-3, pp 112-113) QUANTITATIVE MORPHOLOGICAL AND DYNAMIC STUDY OF THE PORTAL CIRCULATION: SPLENO-PORTAL CINEGAMMAGRAPHY. Syrota, A.; Vinot, J. M.; Roucayrol, J. C.; Paraf, A. 1975. (In French)

From 17th French language symposium on nuclear medicine; Paris, France (2 Jun 1975).

In 17th French language symposium on nuclear medicine. Paris, June 2-4, 1975. Reports and communications. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Biologie).

A portal hypertension exploration technique based on the use of a scintillation camera coupled to a data storage and treatment system is described: spleno-portal cinegammagraphy. It involves four stages: a liver-spleen scintigraph carried out after injection of a technetium-containing colloid to obtain morphological information, an intravenous injection of 1 mCi technetium-labelled albumin microspheres; a spleen puncture with a catheter needle; a fast injection through the catheter of 3 mCi technetium-containing minimicrospheres, followed 30 seconds later by a 12 mCi injection of technetium-labelled red blood cells. The progress of this latter injection provides images of the splenic vein, the portal trunk, derivations if any, the activity distribution inside the liver and the arrival of the tracer at the heart. Quantitative data are calculated from the time-dependent activity variation curves in different zones (spleen, liver, heart, lungs). The different haemodynamic parameters accessible by this method are listed. It is shown that by spleno-portal cinegammagraphy a set of morphological and haemodynamic data useful for diagnostic and prognostic purposes can be obtained during a single examination. (FR)

26334 (CEA-CR-3, pp 114-117) EARLY KINETICS OF IODIDE AND PERTECHNETATE: ESTABLISHMENT OF A COMPARTMENTAL MODEL FROM DATA OBTAINED WITH A SCIN-

TILLATION CAMERA. Brooke, P.; Decostre, P.; Erbsmann, F.; Cantraine, F. 1975. (In French)

From 17th French language symposium on nuclear medicine; Paris, France (2 Jun 1975).

In 17th French language symposium on nuclear medicine. Paris, June 2–4, 1975. Reports and communications. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Biologie).

The early thyroid metabolism of iodide may be described by three parameters: the unidirectional clearance C (active iodide transport from the plasma to the thyroid cells), the leakage coefficient k_{TB} (back-diffusion of thyroid iodide to the plasma) and the organification constant k_b (bonding of iodide to the thyroid proteins). These three parameters were determined, together with their variation under the influence of competing anions such as perchlorate or antithyroid agents such as methyl mercapto imidazol (MMI). After intravenous injection of the tracer dose ^{131}I or ^{99m}Tc) the heart and thyroid activities were measured continuously by external counting with a scintillation camera. The simplest model consistent with facts is a system with 7 compartments for iodide and 6 for pertechnetate. It allows the plasma concentration variation to be determined from the data obtained by external counting, parameters C, k_{TB} and k_b, and MMI-induced organification inhibition. (FR)

26335 (CEA-CR-3, pp 133-135) RESULTS OF 100 ISOTOPIC LUNG ARTERIOGRAMS CARRIED OUT WITH AN IMAGE-INTENSIFIER CAMERA IN PLEURO-PULMONARY PATHOLOGY. Gongora, R.; Perdereau, B.; Gongora, G.; Jammet, H.; Parrot, R.; Boscus, M. 1975. (In French)

From 17th French language symposium on nuclear medicine; Paris, France (2 Jun 1975).

In 17th French language symposium on nuclear medicine. Paris, June 2–4, 1975. Reports and communications. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Biologie).

Because of its great sensitivity the camera equipped with an image intensifier can be used to obtain and examine lung arteriograms. The activity curves were recorded from zones located on the images, themselves recorded on a magnetoscope. Fifty images are available per second, each different from the others and significant. On lung arteriograms recorded in this way were measured: the arrival times, rise times and transit times. A hundred examinations were performed, giving diagnostic information and a means to study many correlations between the isotopic parameters and different causes of diseases. (FR)

26336 (CEA-CR-3, pp 162-165) RADIOIMMUNOLOGICAL DETERMINATION OF PARATHORMONE IN HUMAN SERUM. Baret, A.; Morcellet, J. L.; Sauvan, R.; Piechowski, J. 1975. (In French)

From 17th French language symposium on nuclear medicine; Paris, France (2 Jun 1975).

In 17th French language symposium on nuclear medicine. Paris, June 2–4, 1975. Reports and communications. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Biologie).

The radioimmunological determination of h PTH was studied, using reagents available on the market: purified bovine parathormone (b PTH) from the Wilson laboratories used for labelling and calibration, synthesized amino thermal peptide of b PTH (1-34 b PTH) from the Beckman laboratories, bovine antiparathormone guinea-pig antiserum from the Burrough Wellcome laboratories (AS 211/[illegible]). The results were analysed on standard curves, together with the seric PTH fractions for normal or renal-insufficient subjects. (FR)

26337 (CONF-760121-1) COMPARISON OF POSITRON TOMOGRAPHY AND SCINTIGRAPHY WITH ^{201}Tl FOR DELINEATION OF THE MYOCARDIUM. Fill, H.; Buchin, M.; Harper, P. V.; Muehllehner, G.; Walsh, W.; Resnekov, L.; Mock, B. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1976. Contract E(11-1)-69. 13p. Dep. NTIS $3.50.

From 12th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (12 Jan 1976).

Recent advances in nuclear medicine instrumentation have led to the development of improved positron-imaging systems which exceed in performance the earlier systems which were limited mainly by low count rate capability. This has led to renewed interest in positron imaging in general, primarily because such devices offer better resolution and higher sensitivity than conventional, mechanically collimated gamma cameras, as well as tomographic capability which may provide additional and more accurate information for the clinician. Furthermore, the unique capabilities of positrons for use in reconstructive imaging are beginning to be exploited. In the present report, results are presented from a preliminary study in which longitudinal tomographic myocardial images, produced with ^{81}Rb as the positron-emitting label using the double camera coincidence system are compared with conventional myocardial images obtained with ^{201}Tl and a gamma camera. (auth)

26338 (COO-2427-5) BIOLOGIC CONSIDERATIONS IN ANATOMIC IMAGING WITH RADIONUCLIDES. Final Progress Report, July 1974–June 1975. Potchen, E. J. (Johns Hopkins Univ., Baltimore, Md. (USA). School of Medicine). 1975. Contract E(11-1)-2427. 31p. Dep. NTIS $4.00.

An important task relating to anatomic imaging with radionuclides is the determination of factors which effect the use of imaging procedures. This is important to reduce radiation exposure in the population, to improve the efficacy of diagnostic imaging procedures and finally to provide a basis for evaluating the potential effects of proposed regulation of use rates. In this report we describe a methodology for obtaining clinical data relating to the use of the brain scan in an inner city teaching hospital. The development of a questionnaire suitable for use in a clinical setting and providing both prospective and retrospective data is presented. The results of the use of the questionnaire at the Johns Hopkins Hospital during a three month period in 1974 are shown and discussed. Some preliminary results from these data are given and a method for further analysis is indicated. (auth)

26339 (CRSSA-1973, pp 197-200) RADIOISOTOPIC DETERMINATION OF RAT LIVER ADENOSINE 3', 5'-MONOPHOSPHATE PHOSPHODIESTERASE BY CHROMATOGRAPHY ON ALUMINIUM OXIDE COLUMNS. Tine, J.; Sissoef, I.; Darmon, P.; Rocquet, G. [nd]. (In French)

In Centre de Recherches du Service de Sante des Armees. 1973 scientific works. (Centre de Recherches du Service de Sante des Armees, 75–Paris (France)).

An AMP(c) separation technique was developed, its advantage over other techniques being that is does not involve a 5'-nucleotidase. In the event of a phosphodiesterase activation or inhibition it would otherwise be difficult to establish whether the modified enzyme activity is that of phosphodiesterase or that of 5'-nucleotidase. This method also gives good reproducibility in the separation yields and hence allows mass determinations. Many investigations having shown that 3'5'-adenosine monophosphate phosphohydrolase exists in at least two molecular forms it was decided to work at a high substrate concentration, 2.5 10^{-3}M; the results show that the reaction is linear up to 30 minutes incubation, and furthermore proportional to the quantity of proteins up to at least 180 μg. It is shown in addition that PDE which hydrolyses AMP(c) appears in two forms, one soluble and highly active, the other bound to hepatocyte plasmic membrane but less active. (FR)

26340 (CRSSA-1973, pp 200-202) RADIOIMMUNOASSAY OF 3'5'AMP. Valle, C; Duprey, F. [nd]. (In French)

In Centre de Recherches du Service de Sante des Armees. 1973 scientific works. (Centre de Recherches du Service de Sante des Armees, 75–Paris (France)).

To study systematically the 3'5' AMP variations observed after irradiation a radioimmunological method was developed for the determination of this nucleotide. In these techniques the substance to be analyzed is a large (M above 1000) or a small molecule. In the former case it is antigenic and may be injected as such in an animal which will build antibodies; in the latter case, and this applies to 3'5' AMP, it must be coupled to a large molecule. The following stages are described: preparation of the antigen, coupling of 3'5' AMP to an SAB; vaccination procedure on antibody-supplying rabbits; development of the antisera of each rabbit with time as a function of the number of antigen inoculations; radioimmunological determination of 3'5' AMP with the antisera obtained. (FR)

26341 (IAEA-169(Vol. 1), pp 3 v.; v. 1 p. 225-230) IMPORTANCE OF FISSION PRODUCT NUCLEAR DATA IN LIFE SCIENCES, AGRICULTURE AND INDUSTRIAL TECHNOLOGIES. Kuehn, W. K. G.; Niemann, E. G. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

In life sciences fission product nuclear data (FPND) are required for research work in human and animal sciences for the study of kinetic and static physiological processes in all organs like uptake, retention, secretion, pathways, transfer coefficients etc., and for clinical diagnosis and therapy. In agriculture, fission products (FP) are used in order to study, explain, and attempt to influence and control various biological, physical, and chemical processes occurring in plants, food and soil in relationship to soil-plant-nutrient and soil-plant-atmosphere-irrigation studies. Furthermore, experiments on cultivation, mechanisation and translocation are carried out with different FP. (auth)

26342 (IAEA-169(Vol. 1), pp 3 v.; v. 1 p. 231-234) USE OF FISSION PRODUCT NUCLEAR DATA IN LIFE SCIENCES. Alpen, E. L. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

This paper describes fission product nuclear data as it applies to the life sciences in seven situations. They are external exposure; internal emitters; medical application; sealed sources for Brachy therapy; sealed sources used in teletherapy; environmental pathways; and isotopic applications. Sufficient data are available for the applications discussed. (auth)

26343 (LBL-4633) CEREBRAL IMAGING USING ^{68}Ga DTPA AND THE U.C.S.F. MULTIWIRE PROPORTIONAL CHAMBER POSITRON CAMERA. Hattner, R. S.; Lim, C. B.; Swann, S. J.; Kaufman, L.; Perez-Mendez, V.; Chu, D.; Huberty, J. P.; Price, D. C.; Wilson, C. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-eng-48. 12p. (CONF-751116-34). Dep. NTIS $3.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A multiwire proportional chamber positron camera consisting of four 48 x 48 cm^2 detectors linked to a small digital computer has been designed, constructed, and characterized. Initial clinical application to brain imaging using ^{68}Ga DTPA in 10 patients with brain tumors is described. Tomographic image reconstruction is accomplished by an algorithm determining the intersection of the annihilation photon paths in planes of interest. Final image processing utilizes uniformity correction, simple thresholding, and smoothing. The positron brain images were compared to conventional scintillation brain scans and x-ray computerized axial tomograms (CAT) in each case. The positron studies have shown significant mitigation of confusing superficial activity resulting from craniotomy in comparison to conventional brain scans. Central necrosis of lesions observed in the positron images, but not in the conventional scans, has been confirmed in CAT. Modifications of the camera are being implemented to improve image quality, and these changes combined with the tomography inherent in the positron scans are anticipated to result in images superior in information content to conventional brain scans. (auth)

26344 (PB-239208) DETECTION OF HEPATITIS IN BLOOD. Terminal Report, 1 Jul 1971-31 Dec 1974. Gitnick, G. L. (California Univ., Los Angeles (USA). Center for the Health Sciences). 1 Jan 1975. 146p. NTIS $5.75.

Prepared in cooperation with National Institutes of Health, Rockville, Md. Grant No. N01-HL-3-3005, and N01-HB-12351. See also PB-235020.

To evaluate new hepatitis B antigen (HBAg) assay techniques and their influence on acute and chronic post transfusion hepatitis, recipients of blood units found to be positive by reverse passive hemagglutination (RPHA) and radioimmunoassay (RIA) were prospectively followed by-weekly as were age-sex-race matched control patients. Recipients of units containing hepatitis B antibody (anti-HBs) were similarly followed with controls. Both the RPHA and the confirmatory RIA tests were found to be specific sensitive assays for HBAg and were found to identify blood units likely to cause hepatitis B. Infusion of anti-HBs did not influence the subsequent development of acute post transfusion hepatitis (PTH). PTH was seen in progress to significant forms of chronic liver disease more often than previously appreciated. In other studies, a clustering of cases of fulminant fatal hepatitis was evaluated and was attributed either to environmental factors or to viral virulence unrelated to HBAg subtype. (GRA)

26345 (PB-239611) RADIOIMMUNOASSAY FOR THE QUANTITATIVE DETERMINATION OF HUMAN ANTI-MENINGOCOCCAL ANTIBODIES. Annual Report, 1 Jul 1973-15 Mar 1974. Gotschlich, E. C. (Rockefeller Univ., New York (USA)). 15 May 1974. Contract N01-AI-12502. 11p. NTIS $3.25.

See also PB-221658.

A large number of antibody determinations have been performed on sera of children vaccinated with Group A or Group C meningococcal polysaccharide. These sera were provided through the efforts of NIAID and also from other sources. In addition, a number of sera from individuals with meningococcal disease have also been examined. The author has succeeded in maintaining the reproducibility of radioimmunoassays and has been able to develop a computer program which simplifies the calculations greatly. (GRA)

26346 (STI/PUB-419) TRACER TECHNIQUES FOR PLANT BREEDING. Panel Proceedings Series. Proceedings of a Conference held in Vienna, 2-6 December 1974. (International Atomic Energy Agency, Vienna (Austria)). 1975. 120p. (CONF-741261-). IAEA $7.00.

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

Separate abstracts were prepared for the 12 papers presented at the conference. (HLW)

For abstracts of individual papers see: 26330, and 26375-26385.

26347 BIOSYNTHESIS CHAMBER SYSTEM FOR THE PRODUCTION OF ISOTOPICALLY LABELED TOBACCO. Bass, R. T.; Jenkins, R. W. Jr.; Newell, G. C. Jr.; Osdene, T. S. (Philip Morris Research Center, Richmond). Int. J. Appl. Radiat. Isot.; 26: No. 12, 763-757(1975).

The design, fabrication, and operation of a special plant growth chamber system utilized in the biosynthetic production of ^{14}C labeled tobacco plant material are described. The controlled environmental factors of the system were relative humidity, temperature, carbon dioxide, nutrients, and auxiliary lighting. Four plants of Nicotiana tabacum L. cv. Coker 254 were grown for five weeks in the $^{14}CO_2$ atmosphere of the growth chamber. The four-plant harvest produced a total dry weight yield of 420 g of uniformly labeled ^{14}C-tobacco plant material with an average specific activity of 614 nCi/mg of carbon. (auth)

26348 RADIOACTIVE TRACERS IN THE ASSESSMENT OF CLEANING OF SURGICAL APPLIANCES. Mostafa, A. B. M. G.; Chackett, K. F. (Dudley Road Hospital, Birmingham, Eng.). Int. J. Appl. Radiat. Isot.; 26: No. 11, 651-655(Nov 1975).

Radioactive tracers which may be used in the assessment of cleaning of surgical appliances are described. Five labelled compounds were used as soiling material and tested in the rather severe conditions that exist during cleaning cycles. Measurements of decontamination in two cases were considered reliable but in the other three some degree of decomposition of the soil occurred, which falsified the results. (auth)

26349 NEW METHODS FOR INTRODUCING ^{75}Se INTO RADIOPHARMACEUTICALS. Basmadjian, G. P.; Hetzel, K. R.; Ice, R. D. (Univ. of Michigan, Ann Arbor). Int. J. Appl. Radiat. Isot.; 26: No. 11, 695-697(Nov 1975).

The advantages of ^{75}Se introduction, over the more usual ^{131}I, into radiopharmaceuticals are considered. A simple method for introducing ^{75}Se into an organic molecule during the later steps of chemical synthesis to produce a high specific activity ^{75}Se-radiopharmaceutical is reported. This method is suitable for the synthesis of organic molecules that have the capability of forming a C-Se bond, e.g. selenourea and benzylselenol. The method relies on using the separate useful intermediate labeling reagents, NaH^{75}Se and $Na_2{}^{75}Se_2$, that are stable and can be used as stock solutions for labeling of a variety of radiopharmaceuticals. (UK)

26350 COATING SECTIONS FOR ELECTRON MICROSCOPIC AUTORADIOGRAPHY: A STRIPPING TECHNIQUE USING LIQUID EMULSION. Burry, R. W.; Lasher, R. S. (Univ. of Colorado, Denver). J. Microsc. (Oxford); 104: No. 3, 307-319(Aug 1975).

A coating technique for electron microscope autoradiography is described which combines the advantage of forming an emulsion film by a dipping method with the ease of coating sections already on grids. Sections are coated so that a formvar support film separates the section and the emulsion crystals. This intermediate layer of formvar ensures a random distribution of the emulsion crystals. Using light gold sections, Ilford L-4 emulsion and Microdol-X development, the resolution of this technique, as determined by the half distance method, was 150 nm. The additional layer of formvar slightly reduced the image quality with biological samples in the electron microscope. This technique has a minimal loss of resolution and image quality for moderate resolution electron microscope autoradiography. (auth)

26351 MUONIC X RAYS FROM HEALTHY DOG LIVER AND DOG LIVER WITH A TUMOR. Daniel, H.; Pfeiffer, H. J.; Springer, K. (Techniche Univ., Munich). Phys. Med. Biol.; 20: No. 6, 1035-1036(Nov 1975).

Muonic x-ray spectra have been measured for a pair of samples of normal (healthy) dog liver and pathological dog liver (with a big tumour), in an attempt to detect statistically significant differences in x-ray intensity ratios. The largest deviation from unity in the ratio of values for pathological and normal samples was in the result for the intensity sum of all visible carbon lines divided by the intensity sum of all visible oxygen lines (0.75 ± 0.04). This value was in quantitative agreement with earlier results. (UK)

26352 USE OF ^{113m}In COMPLEX COMPOUNDS WITH SOME AMINO ACIDS FOR SCANNING. Popova, M.; Izunov, I. (Medical

Academy, Plovdiv, Bulgaria). Med. Radiol.; 20: No. 12, 39-41 (1975). (In Russian)

The labelling of the following amino acids by means of ^{113m}In was reported: DL-norvaline, DL-isovaline, DL-methionine, aspartic acid, glumatic acid, hippur, histidine, phenylalanine, and aminobenzoic acid. The percent of binding of ^{113m}In and amino acids was determined by radiochromatographic methods. Scintigraphic examinations were carried out under experimental and clinical conditions after intravenous injection of the labelled compound. The advantages of the labelled compounds and the perspective for their clinical use was pointed out. (auth)

26353 KIT FOR THE RAPID PREPARATION OF /sup 99m/Tc RED BLOOD CELLS. Richards, P.; Smith, T. D. (to U.S. Energy Research and Development Administration). US Patent Application 568,809. Filed date 16 Apr 1975. 10p.

A method and sample kit are described for the preparation of /sup 99m/Tc-labeled red blood cells in a closed, sterile system. A partially evacuated tube, containing a freeze-dried stannous citrate formulation with heparin as an anticoagulant, allows whole blood to be automatically drawn from the patient. The radioisotope is added at the end of the labeling sequence to minimize operator exposure. Consistent 97 percent yields in 20 minutes are obtained with small blood samples. Freeze-dried kits have remained stable after five months. (auth)

26354 GALLIUM-67 SCANS IN CHILDREN WITH SOLID TUMORS. Lepanto, P. B.; Rosenstock, J.; Littman, P.; Alavi, A.; Donaldson, M.; Kuhl, D. E. (Univ. of Pennsylvania, Philadelphia). Am. J. Roentgenol., Radium Ther. Nucl. Med.; 126: No. 1, 179-186(Jan 1976).

From 57th annual meeting of the American Radium Society; Isla Verde, Puerto Rico (4 May 1975).

Twenty pediatric patients with malignant disease were studied by whole-body gallium scans. Seven had Hodgkin's disease, five had soft tissue sarcomas, three had neuroblastomas, two had Wilms' tumors, and one each had a hepatoblastoma, embryonal cell carcinoma, and sacrococcygeal teratoma. Of 50 sites studied, there was a true positive result in 17 percent, and 58 percent there were false negative results. The method served best in patients with Hodgkin's disease, where the true positive rate was 64 percent. In no instance did the gallium scan affect the clinical management of a patient. (auth)

26355 PRACTICAL APPLICATIONS OF RADIOIMMUNOASSAY THEORY. A Simple Procedure Yielding Linear Calibration Curves. Fernandez, A. A.; Loeb, H. G. (Biochemical Procedures, Inc., North Hollywood, CA). Clin. Chem.; 21: No. 8, 1113-1120(Jul 1975).

The fundamental equation describing radioimmunoassays under equilibrium conditions has been recast into a "working equation" in a form more directly applicable to the requirements of the analytical laboratory. Plotting total counts over counts bound vs ligand concentration, which is conveniently linear over most of its course, is shown readily to yield quantitative data relative to binding site concentration and the equilibrium constant and to provide a means for deriving apparent labeled ligand concentration. Such data are helpful in establishing optimum assay conditions and can serve a continuing quality-control function. The working equation also characterizes the binder and tracer reagents used in the assay. The determination of working-equation parameters has been illustrated for the vitamin B_{12} assay. Data are presented for seven different assay procedures, involving more than 600 calibration curves and 100 different lots of binding agent and tracer reagent, showing a consistently high correlation coefficient (r greater than 0.990), between ligand concentration and the response variable. (auth)

26356 ADRENAL IMAGING WITH ^{131}I-19-IODOCHOLESTEROL IN THE DIAGNOSTIC EVALUATION OF PATIENTS WITH ALDOSTERONISM. Seabold, J. E.; Cohen, E. L.; Beierwaltes, W. H.; Hinerman, D. L.; Nishiyama, R. H.; Bookstein, J. J.; Ice, R. D.; Balachandran, S.; (Univ. of Michigan, Ann Arbor). J. Clin. Endocrinol. Metab.; 42: No. 1, 41-51(Jan 1976).

The results of adrenal scintiscans, venograms, and venous aldosterone levels are compared with the histologic findings in 33 patients submitted to operations for primary aldosteronism. Standard and suppression scintiscans were performed 2 to 14 days following intravenous administration of 2 mCi of ^{131}I-19-iodocholesterol. The adrenal lesions were histologically classified into four categories: 25 patients had adenomas, 6 had macronodular hyperplasia, 1 had microscopic hyperplasia, and 1 had an adenocarcinoma. Asymmetrical uptake between the two adrenals seen on standard scintiscans did not differentiate between a tumor or asymmetrical hyperplasia, unless the tumor was greater than 2 cm in diameter. During suppression scintiscans, unilateral uptake visible within five days of the tracer injection was consistent with adenoma. Patients with nodular hyperplasia demonstrated early uptake in both adrenal glands during suppression scintiscans, while the patient with microscopic hyperplasia did not. The type of adrenal lesion was correctly identified in 20/26 (77 percent) of patients by suppression scintiscans; 21/28 (75 percent) of patients by venograms and 12/16 (75 percent) of patients who had adrenal venous aldosterone measurements attempted. The majority of surgically correctible lesions could be identified on suppression adrenal scintiscans. Adrenal vein catheterization can be reserved for those patients in whom the results of suppression scintiscans are inconsistent with the clinical degree of aldosteronism. (auth)

26357 HETEROLOGOUS RADIOIMMUNOASSAY FOR ARGININE VASOPRESSIN. Shimamoto, K.; Murase, T.; Yamaji, T. (Tokyo Univ.). J. Lab. Clin. Med.; 87: No. 2, 338-344(Feb 1976).

A sensitive and specific radioimmunoassay for arginine vasopressin (AVP) was developed utilizing the antisera against lysine vasopressin (LVP) in combination with a labeled AVP. The assay employs an acetone extraction procedure and detects as little as 0.8 pg. per millimeter of AVP in human plasma. In normal subjects, the mean (+- S.D.) plasma concentration of AVP was 4.9 +- 1.2 pg. per milliliter after fluid deprivation and 1.2 +- 0.4 pg. per milliliter after water loading. Plasma AVP levels correlated significantly with plasma osmolalities. In four patients with diabetes insipidus, plasma AVP concentrations ranged from less than 0.8 to 1.2 pg. per milliliter, whereas six patients with the syndrome of inappropriate ADH secretion showed plasma levels of AVP which correspond to those of the dehydrated state in normal subjects or greater, although plasma osmolalities were low in all cases. It was concluded that the present radioimmunoassay method for AVP provides a useful way of assessing neurohypophyseal function in man. (auth)

26358 RADIONUCLIDE LIVER SCANS IN TUMOR DETECTION. Current Concepts. Spencer, R. P. (Univ. of Connecticut Health Center, Farmington). Cancer, Suppl.; 37: No. 1, 475-479 (Jan 1976).

From ACS-NCI national conference on advances in cancer management. II. Detection and diagnosis; Denver, CO, USA (1 May 1975).

Because of the frequency of spread of tumors arising elsewhere to the liver, hepatic evaluation plays a key role in planning therapy. Dynamic radionuclide transit studies depend upon the dual blood supply of the liver (hepatic artery and portal vein) and can be a useful prelude to static imaging, as most intrahepatic tumors have an hepatic arterial blood supply. Since most tumors do not have the ability to accumulate a radioactive colloid, static views are usually obtained after injection of particulates, which are accumulated by the reticuloendothelial system. A gross defect on the radiocolloid scan simply indicates the presence of an intrahepatic abnormality, but does not identify the nature of the lesion. The possible role to be played by use of additional radiopharmaceuticals, with different properties, in identifying the intrahepatic process is discussed. Other uses of liver scans, such as in evaluating the response of known intrahepatic lesions to therapy, are pointed out. (auth)

26359 SKELETAL SCANNING IN NEOPLASTIC DISEASE. O'Mara, R. E. (Univ. of Arizona College of Medicine, Tucson). Cancer, Suppl.; 37: No. 1, 480-486(Jan 1976).

From ACS-NCI national conference on advances in cancer management. II. Detection and diagnosis; Denver, CO, USA (1 May 1975).

Bone imaging techniques are a sensitive and accurate method for the detection of primary and secondary neoplastic disease of the skeleton. Such procedures have been demonstrated to be superior to evaluation via blood chemistry levels or routine skeletal radiographic surveys. These techniques are also helpful in establishing sites for biopsy and for objective evaluation of therapeutic modalities. They suffer the disadvantage of being nonspecific, and as a result, all positive areas identified by scanning techniques should be correlated with radiographic changes. (auth)

26360 RADIONUCLIDE IDENTIFICATION OF TUMORS. Kaplan, W. D.; Adelstein, S. J. (Harvard Medical School, Boston). Cancer, Suppl.; 37: No. 1, 487-495(Jan 1976).

From ACS-NCI national conference on advances in cancer management. II. Detection and diagnosis; Denver, CO, USA (1 May 1975).

Tumor-seeking radiopharmaceuticals have been employed in the diagnosis of primary neoplasms, in the detection of distant disease, particularly in the localization of tumor foci to facilitate biopsies and the planning of radiation portals, and in assessing the response to tumor therapy. At the present, there is no ideal tumor-scanning agent. However, several approaches appear to be useful and offer promise for further study. The greatest experience has been with ^{67}Ga, which has major utility in the staging of Hodgkin's disease, in the diagnosis of bronchogenic carcinoma, in the detec-

tion of certain metastatic brain tumors, in the identification of recurrent disease, and in the noninvasive diagnosis of leukemic complications. A number of radiolabeled antibiotic and chemotherapeutic agents have shown promise, including tetracycline and bleomycin. A major drawback, however, of these agents which is shared with ^{67}Ga is that they appear to be sequestered by inflammatory as well as neoplastic tissue. A most intriguing approach is the use of radiolabeled antibodies to tumor-associated antigens. Animal and clinical experiments have employed antifibrin, antifibrinogen, anticarcinoembryonic antigen, and antiferritin. Theoretically, agents such as these should allow for greater tumor specificity. (auth)

26361 DEUTERIUM OXIDE AS A TOOL FOR THE STUDY OF AMINO ACID METABOLISM. Mitra, R.; Burton, J.; Varner, J. E. (Washington Univ., St. Louis). Anal. Biochem.; 70: No. 1, 1-17 (Jan 1976).

We have used deuterium oxide in nontoxic concentrations to study, in intact seedlings, the biosynthesis of amino acids. The extent and pattern of deuteration, as determined by a gas–liquid chromatograph–mass spectrometer system, permits conclusions about the biosynthesis of individual amino acids and also about their exposure to transaminases and other enzymes that might introduce deuterium into specific positions of the amino acid by exchange. This method could be used to study amino acid biogenesis in any organism that can tolerate 20 to 40 percent deuterium oxide for a period of a few hours to a few days. (auth)

26362 THE CLINICAL VALUE OF SEQUENTIAL RENAL SCANS WITH ^{131}IODO-HIPURAN AND RENAL PERFUSION WITH ^{99m}Tc COMPOUNDS USING COMPUTER ANALYSIS. Hecking, E.; Pfannenstiel, P.; Pixberg, H. U.; Knick, C.; Ammende, H. P.; Stock, S.; Netter, P.; Phillipp, T.; Peters, P. E.; Fiegel, P. (Deutsche Klinik fuer Diagnostik, Wiesbaden (F. R. Germany). Sektion Nuklearmedizin. Fortschr. Geb. Roentgenstr. Nuklearmed.; 123: No. 2, 103-113(Aug 1975). (In German).

11 figs.; 4 tabs.; 48 refs. Part of the thesis by Knick, C.

Two methods of sequential scintigraphy are considered critically: (a) quantitative computer evaluation of nephrograms obtained by a gamma camera using ^{131}Iodo-Hipuran; (b) quantitative flow studies of the kidneys after bolus injections of ^{99m}Tc preparations. Statistical evaluation of data from 171 patients examined by both methods has shown that the isotope nephrogram is not sufficiently sensitive for diagnostic purposes. Isotope nephrography combined with estimations of effective renal plasma flow on each side separately is of value to the urological surgeon by providing important information regarding severe degrees of renal functional impairment. Perfusion measurements, using a gamma camera and ^{99m}Tc preparations, are a promising survey method for the diagnosis of renal artery stenosis. (DE)

26363 RESULTS OF CISTERNOGRAPHY. A Prospective and Retrospective Study. Piroth, H. D.; Glanzmann, C.; Rau, H.; Yonekawa, Y. (Zurich Univ. (Switzerland). Klinik und Poliklinik fuer Radiotherapie und Nuklearmedizin; Zurich Univ. (Switzerland). Neurochirurgische Klinik). Nucl.-Med.; 14: No. 3, 253-262(Aug 1975). (In German).

In a retrospective and prospective study the scintigraphically measured kinetics of intrathecally injected tracers are classified and compared with the final clinical diagnoses confirmed by additional examinations and clinical course. The results of the studies show characteristic dynamics of the tracer in patients without neurological diseases, whereas typically abnormal images are demonstrated in different neurological diseases. (DE)

26364 POTENTIAL USE OF ASCORBIC ACID AS A PITUITARY AND ADRENAL SCINTIGRAPHIC AGENT. Colombetti, L. G.; Mohammedzadeh, A. A. (Loyola Univ., Maywood, Ill. (USA). Stritch School of Medicine; Michael Reese Hospital and Medical Center, Chicago, Ill. (USA)). Nucl.-Med.; 14: No. 3, 285-292(Aug 1975).

The distribution of intravenously administered ^{14}C-ascorbic acid (AA) into various tissues of the dog, and the effect of dexamethasone and ACTH administration on the AA distribution was studied. As a function of time, the differences of ^{14}C-AA distribution between adrenal and surrounding organs become greater, and 24 hours after the administration of the dose, the adrenal to liver ratio, as well as adrenal to kidney, is about 10:1. Also concentration of AA in the pituitary showed a gradual increase and reached its peak between 24 and 48 hours. Dexamethasone administration lowered significantly the uptake of ^{14}C-AA by the adrenals, but did not affect the uptake by the pituitary. Three consecutive days administration of ACTH did not affect the uptake of the drug by either glands, but one single dose of ACTH administered one hour prior to the ^{14}C-AA increased the uptake of AA by both glands. These results indicate that properly labeled AA may be an effective pituitary and adrenal scanning agent. Possible ways of labeling AA without changing its pharmacological properties are suggested. (DE)

26365 MEDICAL RADIOGRAPHY WITH FAST NEUTRONS. Bagge, E.; Enge, W.; Scherzer, R. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik); Duehmke, E. (Kiel Univ. (F. R. Germany). Radiologische Klinik). Atomkernenergie; 26: No. 3, 198-200(1975). (In German).

Fast neutrons were used to obtain a radiographic picture of extended biological objects with the aid of plastic detectors. Medical applications of this method are discussed. (DE)

26366 FAST NEUTRONS FOR RADIODIAGNOSTIC IN MEDICINE. Becker, R.; Hehn, G. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 201-203(1975). (In German).

The application of fast neutrons to radiodiagnostics in medicine was studied by computer simulation. Two- and three-dimensional radiation transport programs were used. As neutron source generators were considered producing 15 MeV-neutrons and fission neutrons of Cf-252. As detector response, the energy deposition in fiber scintillators was used. For neutron diagnostics, simple geometrical configurations of different kinds of human tissue were studied and compared with conventional Roentgen diagnostics. The results show that air cavities behind bone as well as large differences in the hydrogen content can be seen better with neutrons. This is possible, only if narrow beams of neutrons are used to avoid most of the scattered radiation. The total image has to be generated by scanning. (DE)

26367 STUDY OF IODINE METABOLISM IN PREGNANT WOMEN AND PARTURIENTS BY THE RADIOISOTOPE METHOD IN VITRO. Serov, V. N.; Glebova, V. V.; Frenkel, N. G.; Zamoskovnaya, V. A.; Kaluzhina, V. S. Akush. Ginekol.; 5: No. 50, 14-17(May 1974). (In Russian).

In pregnant women in the absence of clinical signs of thyrotoxicosis, an increase in the concentration of thyroxine and increase of the thyroxine-binding capacity of the white cells was observed, which can be considered a compensatory mechanism assuring normal levels of free thyroxine. In later toxicosis a very sharp increase of T3 and T4 was observed in pregnant and parturient women with a tendency to recovery to previous values in the parturient women. During asthenia from labor substantial deviation from the usual regularities was not established. (tr-auth)

26368 ISOTOPIC TECHNIQUES FOR MEASURING THE BIOLOGICAL ACTIVITY IN PLANT RHIZOSPHERE. Warembourg, F. R. (Centre National de la Recherche Scientifique, 34–Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger). Rev. Ecol. Biol. Sol; 12: No. 1, 261-272(1975). (In French)

From meeting on ground ecology; Montpellier, France (30 May 1973).

The use of ^{14}C made it possible to separate root respired CO_2 and microbial CO_2 resulting from exudates utilisation by the rhizosphere microflora. Measurements were done after wheat plants grown under axenic and non axenic conditions were placed during short period of time in an atmosphere containing $^{14}CO_2$. Under axenic conditions evolution of $^{14}CO_2$ follows a bell shaped curve due to the brief appearance of labelled compounds translocated from the aerial part of the plants to the roots. In the presence of microorganisms, the maximum of activity due to root respiration is identical but immediately followed by a second peak of $^{14}CO_2$ evolution that was attributed to the decomposition of labelled exudates by the microflora. The same observations resulted from the labelling of a grassland vegetation sampled with its soil and placed in the laboratory. Preliminary results obtained using this method of short term labelling of plants are presented here. (FR)

26369 TOMOSYNTHESIS MINIMISES RADIATION DOSE IN RADIO DIAGNOSIS. Instrum. Lab.; No. 69, 11-13(Jul 1974). (In French, English)

Two methods of tomosynthesis (opto-holographic method, electronic tomosynthesis) are described, allowing the reduction of the patient's exposure time as well as the radiation exposure levels. (FR)

26370 INHIBITION BY A PURIFIED LIVER EXTRACT OF THE INCORPORATION OF TRITIATED THYMIDINE IN CELL CULTURES OF FOETAL RAT LIVER. Berneman, A.; Ellouz, R.; Lenfant, M.; Giralt, E. G. (Centre National de la Recherche Scientifique, 91–Gif-sur-Yvette (France). Inst. de Chimie des Substances Naturelles; Hopital Paul Brousse, 94–Villejuif (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 281: No. 2, 187-190(21 Jul 1975). (In French)

A dialyzed rat liver extract has been chromatographed on "Sephadex G 25" and then on "Sephadex G 50". A fraction which

inhibits the incorporation of tirtiated thymidine and stimulates the incorporation of labelled orotic acid into foetal rat liver cells in culture was found. This fraction has no effect on DNA synthesis in cell lines derived from lymphocytes and fibroblasts. (FR)

26371 CLINICAL VALUE OF JOINT-SCINTIGRAPHY BY MEANS OF ^{99m}Tc-PERTECHNATE. Wittenborg, A.; Creutzig, H. (Institut fuer Nuklearmedzin und Spezielle Biophysik, Hanover). Verh. Dtsch. Ges. Kreislaufforsch.; 3: 81-82(1972). (In German)

Scintigraphy with ^{99m}Tc-pertechnate was evaluated on 12 controls and 88 patients with degenerative or inflammatory joint diseases. Five of the controls gave false positive results. However in 70% of the diseased patients there was complete agreement between clinical and scintigraphic findings. Scintigraphy corrected some clinical evaluations in which symptoms had been overevaluated because of auxiliary factors. The disadvantages of the method are tabulated. (JSR)

26372 MEASUREMENT OF REGIONAL BRAIN BLOOD FLOW USING ^{133}Xe BEFORE AND AFTER INTRAVENOUS ADMINISTRATION OF THE SO-CALLED VASOACTIVE AND CEREBRAL METABOLIC-ACTIVE DRUGS IN RESEARCH ON ACUTE ILLNESSES. Kohlmeyer, K. (Univ., Giessen, Ger.). Verh. Dtsch. Ges. Kreislaufforsch.; 39: 96-101(1973). (In German)

The results obtained and the conclusions drawn in the administration of eight cerebral-active experimental drugs to patients with acute blood flow malfunctions in the brain were reported. Sympathoplegic substances do not permit the blood flow to increase. Direct muscular-tropic and papvarein-like drugs have a more or less strong cerebral vasodilating effect. An increase of blood flow is possible not only by direct myotropic vasodilation but can arise as a secondary effect in pharmacologically increased metabolic selectivity as activation of the Formatio reticularis. A working hypothesis was presented on the cause of the increased blood flow induced by vasodilaters. (JSR)

26373 SYNTHESIS OF RADIOACTIVE POTENTIAL PERCURSERS OF PEPTIDE MOIETIES FROM ERGOTOXIN ALKOLOIDS. Johne, S.; Goreger, D. (Inst. fuer Biochemie der Pflanzen, Halle, Ger.). Pharmazie; 29: No. 3, 181-186(Mar 1974). (In German)

For biosynthesis studies of peptide moieties from cyclic ergolines, [valyl-^{15}N] lactam, [prolin-U-^{14}C] lactam, [leucyl-U-^{14}C] prolinlactam, leucyl-[prolin-U-^{14}C]-lactam, [phenylalanyl-U-^{14}C]-prolinlactam, [prolyl-U-^{14}C]-alanin, [prolyl-U-^{14}C]-glycine, [valyl-^{15}N]-[leucin-U-^{14}C], [valylvaline]-T and valylleucyl-[prolin-U-^{14}C] were synthesized. The most promising methods were azide, DCCI, mixed anhydride, and activated ester methods. A series of peptide derivatives were synthesized. (tr-auth)

26374 NUCLEAR MEDICINE STUDIES IN THE DIAGNOSIS OF DISEASES OF THE LIVER, PANCREAS, AND SPLEEN. Gumerman, L. W. (Univ. of Pittsburgh). Surg. Clin. North Am.; 55: No. 2, 427-447(Apr 1975).

Nuclear medicine studies of the liver, spleen and pancreas have their major clinical applications in the evaluation of structure. The studies are based on static imaging, the abnormal study being one that differs from the normal in the size, shape, or position of the organ, or in the uniformity of distribution of the radioisotope within it. In a number of conditions, these imaging techniques have added a new and highly reliable method of diagnosis; in some, they can serve as screening or confirmatory studies; in others, their role is more limited or still in dispute. In the sections that follow, my goals are to: (1) provide a brief explanation of the drugs and instruments on which the studies are based; (2) discuss the clinical setting in which radionuclide studies are useful, (3) present the particular advantages of these studies as well as their limitations. (auth)

26375 NEED FOR BETTER SELECTION TECHNIQUES: A PLANT BREEDER'S VIEW. Haensel, A. (Probstdorfer Saatzucht GmbH, Vienna). pp 3-7 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

The main breeding aims are described, and a theoretical consideration of possible combinations of heritability and of correlation to yield of any plant character is presented. The ideal type of character required by the plant breeder in selecting for yield and/or quality is listed, together with subjects on which the plant breeder requires more information. (auth)

26376 NEED AND PROSPECTS FOR USING TRACER TECHNIQUES IN FRUIT BREEDING. Zagaja, S. W. (Research Inst. of Pomology, Skiemiewice, Poland). pp 9-12 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

Compared with staple food crops and fodder crops, the commercial value of fruits depends more on their quality than on their productivity. Modified screening techniques are therefore required for fruit crop improvement. The following are areas of fruit crop improvement in which tracer techniques could be used to speed up the progress: assessment of rootstocks and particularly their effect on vigour of growth and productivity of the trees; assessment of mutants productivity; assessment of adaptability to various habitats of fruit tree cultivars and rootstocks; and juvenility studies on fruit trees, aimed at shortening the juvenile stage. On each of these subjects background information is provided and suggestions are made concerning the scope of research. (auth)

26377 USE OF ISOTOPES TO EXPLORE THE PHYSIOLOGY AND BIOCHEMISTRY OF PHOTORESPIRATION AND ITS EFFECTS ON CROP YIELDS. Keys, A. J.; Bird, I. F.; Cornelius, M. J.; Kumarasinghe, S.; Whittingham, C. P. (Rothamsted Experimental Station, Harpenden, Eng.). pp 13-18 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

Crop yield depends on the rates of photosynthesis, transport of assimilate, growth of useful parts of the plant, photorespiration and dark respiration. Photorespiration is closely associated with photosynthesis; it probably has a direct effect on photosynthetic efficiency and causes a loss of recently assimilated carbon as CO_2. Photorespiration is, however, associated with phosphorylation of ADP to ATP in mitochondria and results in transport of carbon out of the chloroplast. Serine, a major product of photorespiration, is readily converted to sucrose in leaves. Using [^{14}C] serine it was shown that sucrose synthesis from serine required concurrent photosynthetic assimilation of CO_2 and aerobic conditions. This suggests sucrose synthesis from serine may be dependent upon continuing photorespiration for energy and may not directly involve metabolism in the chloroplast. In wheat leaves, much if not all the carbon assimilated in air may be metabolized by the photorespiratory pathway (glycollate pathway). This was shown by rates of change of ^{14}C in intermediates when conditions were changed suddenly from steady photosynthesis in the presence of $^{14}CO_2$. On the other hand, intramolecular labelling of sucrose, following short periods of photosynthesis in $^{14}CO_2$, was not entirely consistent with all sucrose being made from intermediates of the glycollate pathway, even in air containing 150 v. p. m. $^{14}CO_2$. (auth)

26378 ENZYMES IN BIOGENESIS OF PLANT CELL WALL POLYSACCHARIDES: ENZYME CHARACTERIZATION USING TRACER TECHNIQUES. Dickinson, D. B. (State Univ. of New York, Buffalo). pp 19-24 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

Tracers are indispensable in the study of plant enzymes. Labelled compounds are employed in routine enzyme assays and in studies of the kinetic and regulatory properties of enzymes. The advantages of radiochemical enzyme assays include their great sensitivity and specificity. These permit assays of crude plant extracts, often in the presence of inhibitors of contaminating enzymes that would interfere with a less sensitive type of assay. Potential disadvantages of radiochemical assays are the time and effort needed to separate labelled product from labelled substrate, particularly if solubility properties or net electrical charges of these compounds are not sufficiently different to permit rapid separation by solvent extraction or ion-exchange chromatography. Isotope effects are seldom a problem for biologists. Our research deals with enzymes and metabolic pathways by which starch and cell wall polysaccharides are formed. The goal is to learn how these processes are regulated and particularly to identify the enzymatic regulatory mechanisms involved. Germinating lily pollen is used for studies of cell wall formation; both pollen and maize endosperm are used for studies of starch biosynthesis. Hexokinase is the first step in conversion of hexoses to starch, wall polysaccharides and respiratory substrates. The maize endosperm enzyme was assayed by its conversion of ^{14}C-hexose to ^{14}C-hexose-6-P, and rapid separation of the two labelled compounds on anion-exchange paper. (auth)

26379 SOME NUCLEAR TECHNIQUES APPLICABLE FOR PHYSIOLOGICAL CHARACTERIZATION OF PLANT MATERIAL. Antoszewski, R. (Research Inst. of Pomology, Skiemiewice, Poland). pp 25-30 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

The following nuclear techniques and apparatus based on application of radioactive isotopes are described: a laboratory set-up for studying minute changes in water content of intact plants based on beta-ray absorption emitted by ^{14}C; a field apparatus for studying the water balance in leaves of intact plants under field conditions based on the same principle; a laboratory set-up for measuring the water balance in fruit based on beta-ray penetration emitted by ^{32}P; and a modified Shimshi apparatus. The idea of so called "transport economy" in a plant system is introduced, and some methods of measuring it are proposed. (auth)

26380 TRACER TECHNIQUES IN PLANT BREEDING PROGRAMMES. Lupton, F. G. H. (Plant Breeding Inst., Cambridge, Eng.). pp 31-42 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

Tracer techniques may be used as a tool in plant breeding programs either to help in the choice of parental combinations with complementary advantages or in the selection of desirable plants within the segregating populations. The second application is, however, of little practical application as the techniques involved are mostly too tedious to be used on the large populations with which the plant breeder must deal and frequently involve unacceptable destructive sampling of his material. The physiological analysis of potential parents is of considerable importance, particularly in the improvement of crops to be grown in more fully developed countries with advanced agricultural systems. Techniques using radioactive tracers and radiation-emitting sources such as the neutron probe have played a considerable part in this work. They have been used by cereal breeders to measure photosynthesis either of individual leaves, or of undisturbed crop canopies, and by breeders of many crops in the study of the translocation of the products of photosynthesis within the plant. They have also been used in studies of the effects of plant diseases on translocation patterns, thus identifying limiting factors for which the breeder should select. Radioactive tracers have also been used in estimating varietal differences in root growth and distribution, but the results obtained from such experiments have indicated that environmental differences are greater than those between genotypes. Differences in water uptake have, however, been demonstrated using the neutron probe, though these differences appear to be much influenced by differences in the water economy of the aerial parts. (auth)

26381 USE OF TRACER TECHNIQUES TO STUDY YIELD COMPONENTS IN SEED CROPS. Stoy, V. (Swedish Seed Association, Svalov). pp 43-55 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

High yield is a main objective in most plant breeding programs and, therefore, a thorough knowledge of the physiological determinants of yield as well as their mode of inheritance ought to be of great value to the breeder. Ideally it should enable him both to select suitable parents for his crossing programs and to screen the offspring from these crosses (as also from treatments with mutagenic agents) for desirable agronomic characters. The production of seeds depends on the magnitude of total dry matter production as well as on the efficiency of transfer of the substances produced to the developing seeds. Both these processes can conveniently be studied with the aid of isotopic tracers. The course of this assimilate translocation and the efficiency of the partitioning system can also be determined very conveniently by using appropriate isotopes. Moreover, pulse labelling at different stages of development and subsequent sequential harvesting make it possible for the investigator to follow the dynamic pattern of assimilate movement and also to describe it in quantitative terms. With the aid of tracers it is often easy to determine which substances are primarily formed during the fixation process, which compounds make the transport forms, and which storage products the translocated compounds finally are incorporated into. It is also possible to elucidate the pathways of biosynthesis of various economically important components of the seeds with methods utilizing the advantages of tracers. Finally it should be pointed out that the movement of assimilates in plants obviously is under hormonal control, and that valuable information about the influence of different hormones and growth regulators on the distribution of labelled assimilates can be obtained in properly designed experiments. This information may subsequently be used both for the external application of growth regulators and for the breeding of crop plants with desired morphological characters. (auth)

26382 PHYSIOLOGICAL SELECTION CRITERIA IN FORAGE GRASSES. Cooper, J. P. (Welsh Plant Breeding Station, Aberystwyth). pp 65-71 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

The plant breeder has to develop varieties that provide the most efficient conversion of environmental inputs and have sufficient resistance to environmental stress. The most important physiological features that determine crop production and for which the plant breeder will have to select are discussed. Tracer studies may be of help to the breeder at the investigational level but in the longer term may also provide direct screening techniques for certain of the important physiological characteristics. (auth)

26383 TRACER TECHNIQUES FOR THE STUDY OF HOST-PARASITE RELATIONS. Mendgen, K. (Univ., Goettingen, Ger.). pp 73-77 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

Autoradiographic techniques were used to study the interactions of many facultative and obligate parasites, including viruses. After feeding the host plant with labelled substrates, labelled material accumulates in the infected cells and seems to penetrate into structures of the parasite. After labelling the parasite, its influence on the host may be studied. We use this technique to study the interaction of host (bean) and parasite (bean rust) during the infection process. After infection with uredospores labelled with tritiated orotic acid, the radioactivity is retained almost completely within the young haustorium at 22 h after inoculation. This may indicate a very small influence of the parasite on its compatible host. In incompatible host-parasite combinations, the infection process proceeds in a different way. The use of autoradiographic techniques to compare combinations of varying compatibilities will be discussed. (auth)

26384 NUCLEAR TECHNIQUES FOR DETERMINING BIOMASS PRODUCTION, EVAPORATION AND TRANSPIRATION, ROOT DEVELOPMENT, AND NUTRITIONAL VALUE. Niemann, E. G.; Kuehn, W.; Kaul, A. K. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Hanover). pp 79-83 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

Some nuclear methods are presented which could be of assistance to the plant breeders in selecting for positive plant characters. Several methods have been developed for the continuous determination of biomass by means of gamma-absorption measurements in single plants as well as in experimental field plots. The response of plant growth to environmental conditions such as fertilization, irrigation, and day length, dependent on genetic parameters can easily be followed by these techniques. Primarily for the investigation of water vapour movement in soils and between soil and atmosphere under conditions of temperature inversions, a technique has been worked out using ^{3}H-labelled water and water vapour. The inclusion of plants in this system will allow the determination of water balance under varying environmental conditions. An autoradiographic method has been applied using ^{86}Rb as trace element mainly for the measurement of root distribution of trees (apple, coffee). Finally, a sequence of analytical steps is described that has been developed and used in Hanover for the selection for protein amount and quality in crop plants. Though not all of these steps include nuclear methods, the application of tracer techniques in this and other screening sequences is an invaluable help for breeders and analysts. (auth)

26385 METHOD USING AMINOACYLATION AND TRANSFER RIBONUCLEIC ACID (tRNA) FROM WHEAT EMBRYO AND ISOTOPE DILUTION FOR SCREENING OF GENOTYPES WITH IMPROVED PROTEIN CONTENT AND QUALITY. Denic, M. (Inst. for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun, Yugoslavia). pp 85-94 of Tracer Techniques for Plant Breeding. Vienna; International Atomic Energy Agency (1975).

From proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974). See STI/PUB-419; CONF-741261-.

The possibilities for screening protein quality in crop plants are considered with special attention given to the determination of limiting amino acids. Conditions for determining lysine and methionine are presented. Because of the high specificity of transfer ribonucleic acid to bind its corresponding amino acid, in principle, it is possible to determine any amino acid that is incorporated into protein. The method is both specific and sensitive. Since it is also rapid and relatively inexpensive, it is useful in studies on breeding for improved protein quality. (auth)

26386 RADIONUCLIDE IMAGING OF THE BONES AND JOINTS OF THE HAND. A Definition of Normal and a Comparison of Sensitivity Using /sup 99m/Tc-Pertechnetate and /sup 99m/Tc-Diphosphonate. Bekerman, C.; Genant, H. K.; Hoffer, P. B.;

Kozin, F.; Ginsberg, M. (Univ. of Chicago). Radiology; 118: No. 3, 653-659(Mar 1976).

Normal radionuclide patterns of the hand obtained with /sup 99m/TcO_4 and /sup 99m/Tc-Sn-EHDP are described and their validity supported by clinical, radiographic, and laboratory examinations performed to exclude articular disease in the control group. Comparison of the /sup 99m/TcO_4 and /sup 99m/Tc-Sn-EHDP images in patients with various articular diseases demonstrated higher sensitivity of /sup 99m/Tc-Sn-EHDP in detection of involved joints; this was also true when the radionuclide images were compared with fine-detail radiographs in patients with rheumatoid arthritis. (auth)

26387 RADIOIMMUNOASSAY OF SERUM CONCENTRATIONS OF MELATONIN IN SHEEP EXPOSED TO DIFFERENT LIGHTING REGIMENS. Rollag, M. D.; Niswender, G. D. (Colorado State Univ., Fort Collins). Endocrinology; 98: No. 2, 484-489 (Feb 1976).

A specific and sensitive double-antibody radioimmunoassay for melatonin (N-acetyl-5-methoxytryptamine) was developed. The least detectable concentration of melatonin standard was 10 pmolar (2.3 pg/tube) with 50 percent inhibition resulting when the concentration was 100 pmolar (23 pg/tube). Inhibition curves obtained with increasing quantities of melatonin or increasing quantities of chloroform extracts of ovine sera were parallel. Concentrations of melatonin could be accurately determined when 31 to 1000 pg were added to 1 ml ovine serum. Serum samples with melatonin concentrations of 1000 pg/ml, 500 pg/ml and 75 pg/ml had intra-assay coefficients of variation of 9.1 percent, 8.6 percent, and 17.4 percent, respectively. The respective inter-assay coefficients of variation were 22.7 percent, 18.1 percent, and 37.1 percent. Ewes exposed to a 12 h light:12 h dark lighting regimen demonstrated a circadian rhythm in serum concentrations of melatonin. Concentrations ranged from 10 to 30 pg/ml during periods of light to 100 to 300 pg/ml during periods of dark. During exposure to continuous light, the circadian rhythm was abolished and concentrations of melatonin were maintained at 10 to 50 pg/ml. When exposed to conditions of continuous dark the circadian rhythm persisted. A precipitous drop in serum concentrations of melatonin resulted when ewes experiencing peak melatonin concentrations were exposed to light. Concentrations returned to peak levels when the lights were turned off 3.5 h later. (auth)

26388 TECHNETIUM/sup 99m/Tc MACROAGGREGATED ALBUMIN LUNG SCANS. Use in Chronic Childhood Asthma. Hyde, J. S. (Rush Medical School, Chicago); Koch, D. F.; Isenberg, P. D.; Werner, P. J. Am. Med. Assoc.; 235: No. 11, 1125-1130(15 Mar 1976).

Serial roentgenograms and technetium /sub 99m/Tc macroaggregated albumin lung scans were done simultaneously in 30 bronchodilator-dependent asthmatic children and young adults during both relative remission and attacks of status asthmaticus. When chest roentgenograms showed air trapping and increased peribronchial vascular markings associated with persistent perfusion defects, the children benefited from further laboratory studies and continuous comprehensive therapy. Serial scans provided information about underperfusion that was not discernible either by roentgenograms or by usual blood gas studies. Also, lung scans are easier to obtain in children with long-standing asthma than are detailed pulmonary tests. In our study, technetium /sup 99m/Tc macroaggregated albumin scans showed persistent regional perfusion defects in 20 children with chronic asthma during relative remission and exacerbations. (auth)

26389 ROLE OF PLASMIN ON THE DOUBLE ANTIBODY RADIOIMMUNOASSAY OF CARCINOEMBRYONIC ANTIGEN IN HUMAN BLOOD SAMPLES. Das, S.; Das, B. R. (National Cancer Inst. Immunodiagnostic Reference Center, Springfield, VA). J. Immunol.; 116: No. 3, 761-765(Mar 1976).

Double antibody radioimmunoassay (RIA) of carcinoembryonic antigen (CEA) on a series of freshly drawn out concurrent plasma and serum samples of normal human blood donors showed that the serum CEA values were invariably higher than the corresponding plasma CEA values. Extraneous addition of fibrinogen brought down the serum-CEA level to a value comparable to or less than the corresponding plasma value. The effect of certain factors associated with blood clotting, particularly Ca^{++}, fibrinogen, and the fibrinolytic enzyme plasmin, was investigated. Ca^{++} was shown to play no role whereas the effect of fibrinogen was shown to be indirect in that it served as a specific substrate for plasmin, thereby preventing the plasmin degradation of the primary antibody used in the RIA. The finding stresses the role of enzymes like plasmin in double antibody RIA in general and may explain some of the anomalous results obtained when testing biologic material containing plasmin-like substances. (auth)

MATERIALS

26390 (AEC-tr-7297/3) UKRAINIAN PHYSICS JOURNAL. Translated from Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 3, 419-633 (Mar 1971). 220p. (TT-72-52017/03). Dep. NTIS $7.75.

A cover-to-cover translation into English of the March 1971 issue of the Ukrainian Physics Journal (Ukrainskii Fizicheskii Zhurnal, Vol. 16, No. 3) is given. Solid-state physics and properties of materials are prominent in this issue, but articles on lasers, cosmology, atomic and nuclear physics, and plasma occur as well. Items within the subject scope of NSA were cited therein from the original-language publication. (RWR)

Ceramics and Cermets

Refer also to abstracts 25416, 25474, 25735, 25816, 26119, 26569, 26573, 26575, 26607, 26616, 26781, 26809, 26824, 26830, 26836, 26837, 26875, and 28212.

26391 (AD/A-008438) THE THERMODYNAMICS OF THORIUM–OXYGEN AND URANIUM–OXYGEN SYSTEMS. Final Report, 14 Jun 1973-30 Jun 1974. Abramowitz, S. (National Bureau of Standards, Washington, D. C. (USA)). 19 Feb 1975. 30p. NTIS $3.75.

The vapor pressure data for the uranium–oxygen and thorium–oxygen systems have been reviewed. Free energies of formation for the species UO, UO_2, ThO, and ThO_2 have been chosen. Tables of thermodynamic functions for these species are presented. (GRA)

26392 (AED-CONF-75-449-001) THE STOICHIOMETRY DEPENDENCE OF THE Eu^{153} SPIN-SPIN RELAXATION IN EuO. Arons, R. R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). 1975. 3p. INIS.

From discussion meeting on magnetic semiconductors; Juelich, F. R. Germany (29 Sep 1975).

Spin-spin relaxation curves of a few EuO samples having different composition were measured and compared. It is shown that the measurement of the spin-spin relaxation is a sensitive method to investigate deviations from the stoichiometry in EuO. (DE)

26393 (AED-CONF-75-449-002) THE SYMMETRIES OF MAGNETIC STRUCTURES IN RARE EARTH TETRABORIDES. Schaefer, W.; Will, G.; Buschow, K. H. J. (Philips Gloeilampenfabrieken N.V., Eindhoven (Netherlands)). 1975. 13p. INIS.

From discussion meeting on magnetic semiconductor; Juelich, F. R. Germany (29 Sep 1975).

With abstract.

The collinear antiferromagnetic spin configurations, which are possible in the rare earth tetraboride structure (space group P 4/mbm) and their distinction by neutron diffraction are discussed. The symmetries of the different antiferromagnetic structures are described by the corresponding magnetic space groups. Neutron diffraction data collected from ErB_4 are integrated in the structure discussion. (DE)

26394 (CEA-CONF-3158) INDIUM OXIDE DEPOSITION ON GLASS BY AEROSOL PYROLYSIS (PYROSOL (R) PROCESS). Blandenet, G.; Lagarde, Y.; Spitz, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 28 Apr 1975. 14p. INIS.

From 5th international conference on chemical vapour deposition (CVD-5); Stoke Poges, UK (22 Sep 1975).

The pyrosol (R) process involves the pyrolysis of an aerosol generated by ultrasonic nebulisation from a solution of organic or inorganic compounds. This technique was used to deposit transparent n-conducting indium oxide films on glass. The electrical and optical properties of these films were studied as a function of the deposition temperature and doping (using tin or fluorine). A deposition temperature of 480°C and a Sn/In ratio of about 5% gave the best results. In this case, the transmission in the visible range was 92%, the infrared reflection 84% and the electrical resistivity 1.7×10^{-4} ohm.cm. (FR)

26395 (CEA-CONF-3159) PREPARATION OF NIOBIUM NITRIDE AND NIOBIUM CARBONITRIDE THIN FILMS BY REACTIVE SPUTTERING. Spitz, J.; Aubert, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 28 Apr 1975. 12p. INIS.

From 5th international conference on chemical vapour deposition (CVD-5); Stoke Poges, UK (22 Sep 1975).

The preparation of niobium nitride and carbonitride thin films by reactive sputtering either of a niobium or niobium-carbon target under partial pressure of nitrogen or nitrogen and methane has been studied. The influence of the experimental conditions on composition, structure and electrical properties of the deposited materials is investigated in each case. The correlations observed between the nature of the deposited materials and their superconductive properties are related. (FR)

26396 (CEA-N-1824) ATOMIC DIFFUSION IN A PALLADIUM-SILICON AMORPHOUS ALLOY. Birac, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium; Paris-11 Univ., 91-Orsay (France)). Sep 1975. 55p. (In French). INIS.

The diffusion of ^{63}Ni and ^{6}Li in a $^{80}Pd\ ^{20}Si$ amorphous alloy was studied by a nondestructive tracer method. For the diffusion coefficient of Ni at 290°C only an upper limit of 6×10^{-18} $cm^2\ s^{-1}$ could be obtained by counting the β activity of nickel. In the case of Li, the tracks of α particles due to the (n,α) reaction produced in a nuclear reactor are detected. The diffusion coefficients vary from $(0.2 \pm 0.1)\ 10^{-15}$ $cm^2\ s^{-1}$ to $(60.6 \pm 10)\ 10^{-15}$ $cm^2\ s^{-1}$ between 240 and 290°C. An activation energy does not exist, as in a crystalline solid, for the diffusion mechanism of Li in amorphous alloy $^{80}Pd\ ^{20}Si$. (FR)

26397 (CONF-750595-7) INVESTIGATIONS ON CERMET ELECTRODES FOR THERMIONIC EMITTERS. Schmidt, D.; Nazare, S. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (F. R. Germany). Inst. fuer Energiewandlung und Elektrische Antriebe; Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). 1975. 6p. INIS.

From 4th European symposium for powder metallurgy; Grenoble, France (13 May 1975).

Unstable Ba_2CaWO_6-W with their own supply of Ba, as well as stable UO_2-Mo-emitter cermets that have to be operated with an external Ba-source, have been prepared by axial hot pressing. The relevant properties of these cermets such as electrical resistivity and thermal expansion are reported and compared with theoretical predictions. The electron emission of these materials is discussed on the basis of the surface films formed. It provides the basis for optimising the behavior of these materials. (FR)

26398 (CONF-750595-9) THE PREPARATION OF CERIUM OXIDE BY THERMAL DECOMPOSITION AND THE DETERMINATION OF THE PARTICLE CHARACTERISTICS. Horsley, S.; Towner, J. M.; Waldron, M. B. (Surrey Univ., Guildford (UK)). 1975. 5p. INIS.

From 4th European symposium for powder metallurgy; Grenoble, France (13 May 1975).

Cerium (IV) oxides were prepared by selective thermal treatment of cerium(III) oxalate. The "activity" of these powders was assessed by several techniques including gas adsorption, x-ray line broadening, differential scanning calorimetry, electron microscopy, and heterogeneous catalysis studies. The compaction and the initial sintering stages of fine powders are known to be affected by the absolute particle size, the surface chemistry and the structure of the material. The general concept of "activity" has been used to describe the effects of these properties on the behavior of powder compacts. The degree of interrelation between several possible causes of "activity" are explored. The variation in the amount of energy stored in the surface and the bulk of differently prepared powders is considered in relation to the probable mode of solid state decomposition of the oxalate salt. The possibility of measuring the release of such "strain" energies is discussed. The influence of lattice disorder on the heterogeneous catalysis properties of the powders is also considered. (FR)

26399 (CONF-750595-10) INVESTIGATIONS ON THE CONDITIONS FOR OBTAINING HIGH DENSITY BORON CARBIDE BY SINTERING. Kislyj, P. S.; Grabtschuk, B. L. (AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya). 1975. 9p. (In German). INIS.

From 4th European symposium for powder metallurgy; Grenoble, France (13 May 1975).

The results of investigations on kinetics of condensation and mechanisms of mass transfer in the process of sintering of technical, chemically pure and synthesized boron carbide are generalized. Laws on boron carbide densification depending upon temperature, time of isothermic endurance, thermal speed, size of powder particles and variable composition in homogeneity are determined. From the results obtained on condensation kinetics and special experiments on studying the changes in properties after heating under different conditions, the role of dislocation and diffusion processes in mass transfer during boron carbide sintering is exposed. The properties of sintered boron carbide are 15-20% lower than the properties of high-pressed

one, that is conditioned by intercrystalline distortion of the first one and transcrystallite of the second one. (FR)

26400 (CONF-760209-9) DEUTERON AND HELIUM ION IRRADIATION OF CERAMIC COATINGS ON Nb–1 percent Zr. Rossing, T. D.; Kaminsky, M.; Das, S. K. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 14p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

The surface damage to insulating barium alumino-silicate glass coatings due to irradiation by 100 and 250 keV deuterons and helium ions at room temperature and at 300°C has been studied. Blisters are observed after irradiation at room temperature with both deuterons and helium ions with energies of 100 and 250 keV. For deuteron irradiation a large fraction of the blisters have diameters which are approximately 3 to 5 times larger than the diameter observed with helium ions for identical irradiation conditions, but the density of blisters is nearly an order of magnitude lower. For irradiation at 300°C, no blisters are observed with either type of particle. The sharp rise in permeation rate with temperature is thought to be responsible for this behavior. The blister skin thicknesses have been measured and correlated with calculated projected-range values.

26401 (HEDL-TME-75-104) THERMAL PROPERTIES OF B_4C AND Eu_2O_3. Gibby, R. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1975. Contract AT(45-1)2170. 22p. AT.

The enthalpy and heat capacity of B_4C have been determined between room temperature and approximately 1500°C for both irradiated and unirradiated samples. An effect of irradiation on the measured enthalpy was not observed. The thermal diffusivity and thermal conductivity of approximately 92 percent theoretical density Eu_2O_3 were determined between room temperature and approximately 1300°C. The thermal conductivity of cubic Eu_2O_3 was approximately 19 percent higher than that of the monoclinic form at 100°C, but approaches the thermal conductivity of the monoclinic form at the cubic-monoclinic transition temperature (1050°C). (auth)

26402 (IS-T-691) SELF-DIFFUSION OF ^{60}Co IN CRYSTALS OF Co/sub 1-x/O. Rahman, S. F. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-Eng-82. 138p. Dep. NTIS $6.00.

Thesis.

Tracer self-diffusion coefficients were measured as functions of temperature and deviations from stoichiometry. The arc-transfer technique of crystal growth was found to produce crystal of Co/sub 1-x/O of essentially the same purity as the starting Co rod, and the quality was comparable to commercially available crystals grown by Verneuil process. Measurements at x equals 0.005 in Co/sub 1-x/O showed the Co tracer self-diffusion coefficient to be D equals 3.88×10^{-4} exp [(–31600 ← 2400)/RT] cm^2/s between 1037 and 1350°C. This activation energy is in agreement with measurements made in air, if proper compensation is made for the effect of variation in stoichiometry. Measurements on crystals having deviations between 0.002 and 0.008 at 1150°C showed the diffusion coefficient to depend on p/sub O_2/ as D equals 9.74×10^{-9} p/sub O_2//sup 1/3.59/ cm^2/s, where p/sub O_2/ varied between $10^{-2.5}$ and $10^{-0.25}$ atm. Comparison with thermogravimetric and electrical conductivity measurements confirms that the defects responsible for Co diffusion in the range of temperature and p/sub O_2/ of this investigation are singly ionized cobalt vacancies. The Co tracer self-diffusion coefficients in single crystals are nearly identical to those in polycrystalline Co/sub 1-x/O. 53 references, 29 fig, 6 tables (DLC)

26403 (KFK–2226) INFLUENCE OF DEACTIVATION PROCESSES ON SINTERING OF UO_2-OXIDE FUEL. Pollanz, H.; Gutu, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Nov 1975. 40p. (In German). Dep. NTIS (US Sales Only) $4.00.

Methods were studied of sintering and final density control by deactivation processes using UO_2-oxide fuel. It was shown that sinterability decreases as a function of heating rate, the influence on final densities of sintered compacts being very small. Activated sintering by addition of ppM-amounts of water vapor to the sintering gas will influence pellet densities in a specific way.

26404 (ORNL/TM-5133) URANIUM DISPERSION IN THE COATING OF WEAK-ACID-RESIN-DEPRIVED HTGR FUEL MICROSPHERES. Weber, G. W.; Beatty, R. L.; Tennery, V. J.; Lackey, W. J. Jr. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 44p. Dep. NTIS $5.50.

The current reference HTGR recycle fuel particle is a UO_2/UC_2 kernel with a Triso coating comprising a low-density pyrocarbon (PyC) buffer, a high-density PyC inner LTI coating, SiC, and a high-density PyC outer LTI. The kernel is fabricated from a weak-acid ion exchange resin (WAR). Microradiographic examination of coated WAR particles has demonstrated that considerable U can be transferred from the kernel to the buffer coating during fabrication. Investigation of causes of fuel dispersion has indicated several different factors that contribute to fuel redistribution if not properly controlled. The presence of a nonequilibrium UC/sub 1-x/O/sub x/ (0 less than or equal to x less than or equal to 0.3) phase had no significant effect on initiating fuel dispersion. Gross exposure of the completed fuel kernel to ambient atmosphere or to water vapor at room temperature produced very minimal levels of dispersion. Exposure of the fuel to perchloroethylene during buffer and inner LTI deposition produced massive redistribution. Fuel redistribution observed in Triso-coated particles results from permeation of the inner LTI by HCl during SiC deposition. As the decomposition of CH_3Cl_3Si is used to deposit SiC, chlorine is readily available during this process. The permeability of the inner LTI coating has a marked effect on the extent of this mode of fuel dispersion. LTI permeability was determined by chlorine leaching studies to be a strong function of density, coating gas dilution, and coating temperature but relatively unaffected by application of a seal coat, variations in coating thickness, and annealing at 1800°C. Mechanical attrition of the kernels during processing was identified as a potential source of U-bearing fines that may be incorporated into the coating in some circumstances. (auth)

26405 TECHNIQUES FOR ULTRAFAST QUENCHING (SPLAT COOLING) OF REFRACTORY OXIDES. Revcolevschi, A. (Centre National de la Recherche Scientifique, Vitry-sur-Seine, France); Rouanet, A.; Sibieude, F.; Suzuki, T. High Temp.–High Pressures; 7: No. 2, 209-214(1975).

Splat cooling techniques suitable for quenching of pure and mixed oxides from temperatures above 2000°C at rates of $\sim 10^{5-6}$ K s^{-1} are reviewed. They include projection of the liquid oxide at a very high velocity against a metal plate with the use of a plasmatron or shock waves, and squeezing the molten sample between two metallic bodies (hammer and anvil, or rollers). (auth)

26406 CO-DEPOSITION OF ZIRCONIUM WITH CARBON BY THE BROMIDE PROCESS. Ikawa, K. (Japan Atomic Energy Research Inst., Tokai). J. Less-Common Met.; 44: 207-213 (Jan 1976).

Zirconium was co-deposited with carbon, at temperatures below 1400°C, onto plates of graphite, alumina, and silicon carbide, respectively, in a flow process, in order to obtain deposits with compositions between zirconium carbide and carbon. Zirconium tetrabromide and methane served as sources of zirconium and carbon, respectively. The effect of the gas-phase composition on the deposition behavior was investigated. The deposits could be divided into four regions, plain, mosaic, fiber, and granular, on the basis of the appearance of the surface. The regions showed characteristic patterns in the x-ray diffraction examination. In most cases, the densities of the deposits were considerably lower than the theoretical values. (auth)

26407 SYNTHESIS OF COMPLEX NIOBATES (IV) WITH THE PEROVSKITE STRUCTURE. Kasimov, G. G.; Vovkotrub, E. G.; Dvoinin, V. I. (Ural Polytechnical Inst., Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 665(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 772(Apr 1975).

Sr_2ENbO_6 compounds (E = Ti, Zr, Hf) were synthesized by the reaction in vacuum $Sr_2ENb_{0.8}O_6 + 0.2Nb \rightarrow Sr_2ENbO_6$. They are blue, stable up to 200°C in air, semiconductors, and paramagnetic. Their lattice constants are listed along with that of $SrZrO_3$. (DLC)

26408 PRODUCTION OF NITRIDE MATERIALS BY NITRIDING ALUMINUM DODECABORIDE BLANKS. Samsonov, G. V.; Prikhod'ko, L. I.; Borshch, N. I. (Kiev Polytechnical Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 564-566 (Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 657-660(Apr 1975).

When aluminum dodecaboride powder is heated in nitrogen at 1400–2000°C, it reacts with the latter to form boron and aluminum nitrides. The rate of nitriding reaches a maximum at 2000°C. Sintering of the specimens is accompanied by a decrease in size, and their porosity is 20–22%. The structure of aluminum nitride obtained by nitriding aluminum dodecaboride is distorted and the lattice constant is heightened; this indicates formation of a solid solution (Al, B)N. Formation of solid solutions of nitrides and virtually molecular mixing of the nitride phases ensure high electrical properties of the material obtained.

26409 PARTICLE SIZE OF $^{238}PuO_2$ OBTAINED BY OXALATE PRECIPITATION AND CALCINATION. Rankin, D. T.; Burney, G. A. (Savannah River Lab., Aiken, SC). Am. Ceram. Soc. Bull.; 54: No. 12, 1061-1065(Dec 1975).

From joint fall meeting of the basic science and nuclear divisions of the American Ceramic Society; Williamsburg, VA, USA (1 Oct 1974).

The factors determining particle size distribution and morphology during precipitation of ^{238}Pu oxalate and calcination to $^{238}PuO_2$ were investigated. The manner and rate of solution addition and the rate of mixing during precipitation were the key variables in controlling particle size. A decrease in particle size of calcined $^{238}PuO_2$ with aging time was also noted. (auth)

26410 INFLUENCE OF ERBIUM IONS ON THE MAGNETIC PROPERTIES OF ERBIUM IRON GARNET. Belyaeva, A.I.; Vaishnoras, R.A.; Silaev, V.I.; Stel'makhov, Yu.N. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Solid State 17: No. 6, 1196-1197 (June 1975).

An external magnetic field was applied to samples of $Er_3Fe_5O_{12}$ and $Y_3Fe_5O_{12}+5\%$ Er^{3+}. The absorption band in the vicinity of the $^4I_{15/2}\rightarrow{}^4S_{3/2}$ transition was studied to determine the magnetic moment of Er^{3+} as well as the centers of gravity of the Kramers doublets. (AIP)

26411 INVESTIGATION OF HYPERFINE INTERACTIONS IN RARE-EARTH ORTHOFERRITES BY THE Fe^{57} NMR METHOD. Doroshev, V.D.; Klochan, V.A.; Kovtun, N.M.; Solov'ev, E.E. (Physicotechnical Institute, Donetsk). Sov. Phys.—Solid State 17: No. 8, 1501-1503 (Aug 1975).

The spin echo method was used in measurements of the hyperfine fields on the Fe^{57} nuclei in the orthoferrites $LaFeO_3$, $PrFeO_3$, $GdFeO_3$, $ErFeO_3$, $TmFeO_3$, and $YbFeO_3$ at 4.2 °K, in $HoFeO_3$ at 41 °K, and in $NdFeO_3$ at 77 °K. The reduction of the hyperfine field along the orthoferrite series from 565.9 kOe ($LaFeO_3$) to 550.5 kOe ($LuFeO_3$) was explained by indirect hyperfine interactions. The results were compared with similar data obtained by the Mössbauer spectroscopy method. (auth)

26412 EFFECT OF IRON IMPURITY CONCENTRATION ON KINETICS ORDER OF THERMOLUMINESCENT BLUE EMISSION IN MgO SINGLE CRYSTALS. Takeuchi, N.; Inabe, K.; Nanto, H. (Kanazawa, Univ., Japan). Solid State Commun.; 17: No. 10, 1267-1269(15 Nov 1975).

Thermoluminescence has been measured for two kinds of MgO single crystals. The kinetics of the 94°C glow peak for the blue emission was found to be second order for a sample containing iron in low concentration, while 1.3-order for one appreciably in high concentration. The result was discussed in terms of the concentrations of the recombination and retrapping centers. (auth)

26413 VACANCY MIGRATION IN URANIUM DIOXIDE. Catlow, C. R. A.; Lidiard, A. B.; Norgett, M. J. (UKAEA Research Corp., Harwell, Eng.). J. Phys., C (London); 8: No. 21, L435-L438(7 Nov 1975).

Recent calculations by Van der Voort (J. Phys. C: Solid St. Phys.; 7:L395 (1974)) on vacancy migration in UO_2 are shown to be erroneous. The predicted high activation energies for this process are due to fundamental inadequacies in the lattice model. The suggested agreement between such results and experimental results is itself based on a misinterpretation of the published diffusion data. Transport studies on fluorite oxides are briefly discussed and are shown to be compatible with the high mobility of the vacancies suggested by Catlow and Lidiard (Proc. Thermodynamics of Nuclear Materials (IAEA symposium; IAEA-SM-190) vol II:27(1974)). (auth)

26414 MOESSBAUER STUDIES OF Np HYDRIDES. Mintz, M. H. (Israel Atomic Energy Commission, Beersheba); Gal, J.; Hadari, Z.; Bixon, M. J. Phys. Chem. Solids; 37: No. 1, 1-4 (1976).

The Moessbauer spectra of ^{237}Np in NpH_{2+x}(x = 0.1, 0.3 and 0.5) consist of several absorption lines which are attributed to Np inequivalent sites corresponding to different numbers of octahedral hydrogen neighbors. The relative intensities of the various lines do not correspond to a random distribution of the hydrogen ions. A model which takes into account first nearest neighbor interactions among octahedral hydrogen ions can reproduce the experimental spectra. (auth)

26415 INFLUENCE OF EXCESS OXYGEN ON THE ELASTIC PROPERTIES OF NON-STOICHIOMETRIC SrO CRYSTALS. Pai, S. Y.; Sivertsen, J. M. (Univ. of Minnesota, Minneapolis). J. Phys. Chem. Solids; 37: No. 1, 17-25(1976).

Measurements have been carried out of the elastic constants of SrO in the virgin undoped state and of the changes produced in them by equilibrium doping with oxygen at ≃ 1200°C and oxygen partial pressure of 0.95 atm. The method used was Papadakis' pulse-echo overlap technique in conjunction with thermogravimetric analysis (T.G.A.) to determine mass and density changes due to oxygen doping. The values obtained for C_{11}, C_{12}, C_{44} of the virgin crystal at 23°C are $C_{11} = 17.60 \pm 0.03 \times 10^{11}$ dynes/cm^2; $C_{12} = 4.808 \pm 0.007 \times 10^{11}$ dynes/cm^2; $C_{44} = 5.577 \pm 0.008 \times 10^{11}$ dynes/cm^2. (These values are in very good agreement with those of Son and Bartels (J. Phys. Chem. Solids; 33: 819(1971)). Values for $\delta C_{11}/C_{11}$ and $\delta C_{44}/C_{44}$ were found to be −1.74% and −0.86% respectively. Accurate values for $\delta C_{12}/C_{12}$ could not be obtained because of sample size limitations after quenching. However, C_{12} was shown to definitely increase due to doping. Analysis of the results indicates that the elastic modulus changes can only be attributed to the formation of cation vacancies during doping. The T.G.A. behavior results indicate that this cation vacancy formation is probably associated with the presence of various tripositive cation and uninegative anion species depending on the impurity concentrations of the sample. This implied impurity-controlled cation vacancy concentration is consistent with the earlier observed extrinsic nature of cation diffusion in SrO at 1200°C. (auth)

26416 CHARGE DENSITY WAVES IN 2H-$NbSe_2$. Williams, P. M. (Imperial Coll. of Science and Tech., London); Scruby, C. B.; Tatlock, G. J. Solid State Commun.; 17: No. 9, 1197-1200 (1 Nov 1975).

The formation of a weak superlattice in transmission electron diffraction patterns of the hexagonal layered superconductor 2H-$NbSe_2$ below 35°K is reported. Based on the temperature dependence of the superlattice reflexion intensity down to 17°K and by comparison with related layer materials, an interpretation of these effects in terms of a charge density wave coupled to a periodic lattice distortion is proposed. (auth)

26417 NMR STUDY OF HYDROGEN DIFFUSION IN URANIUM HYDRIDE. Peretz, M. (Israel Atomic Energy Commission, Yavne); Zamir, D.; Cinader, G.; Hadari, Z. J. Phys. Chem. Solids; 37: No. 1, 105-111(1976).

The diffusion of hydrogen in uranium hydride is studied employing the NMR technique. From measurements of spin-spin relaxation time T_2, the activation energy for hydrogen diffusion in β-UH_3 is determined to be $E_a = (19.25 \pm 0.4)$kcal/mole and the preexponential factor to be $A_o \approx 5 \times 10^{14}$Hz. It is shown that these results are in fair agreement with spin-lattice relaxation time T_1 data. Assuming that hydrogen diffusion proceeds via vacancies whose concentration is temperature dependent, it is concluded that E_a is the sum of the energies of vacancy formation and barrier height, and that A_o contains an entropy change factor. Using vacancy concentration data calculated by Libowitz the barrier height energy is estimated to be $E_b \approx 7$ kcal/mole. Using a value for the frequency of hydrogen vibration ν_o determined from inelastic neutron scattering by Rush et al., the entropy change due to vacancy formation and the hydrogen atom jump is estimated to be about $S/k_B \approx 3$. Similar measurements on samples containing less hydrogen than is needed to compose stoichiometric UH_3, show that the rate of diffusion in enhanced by the presence of excess metal in the sample. The jump frequency at 500°K in UH_3 is found to be $\sim 10^6$Hz while for the two-phase samples of H/U = 2.8 and 2.5, it is larger by a factor of about 3 and 3.5, respectively. (auth)

26418 ^{151}Eu AND ^{57}Fe MOESSBAUER STUDIES OF $EuCoO^3$. Jadhao, V. G.; Singra, R. M.; Rao, G. N.; Bahadur, D.; Rao, C. N. R. (Indian Inst. of Tech., Kanpur). J. Phys. Chem. Solids; 37: No. 1, 113-117(1976).

^{151}Ru and ^{57}Fe Mossbauer spectra of $EuCoO_3$ have been recorded in the 78 to 1200°K temperature range. The spectra along with magnetic susceptibility, x-ray diffraction, and other measurements have been employed to understand the electronic and magnetic properties of $EuCoO_3$. The studies are consistent with Goodenough's description of the electronic properties of $LaCoO_3$. (auth)

26419 EPR STUDY OF THE RKKY INTERACTION IN METALLIC $Eu_xGa_{1-x}B_6$. Glaunsinger, W. S. (Arizona State Univ., Tempe). J. Phys. Chem. Solids; 37: No. 1, 51-57(1976).

The RKKY interaction metallic $Eu_xGd_{1-x}B_6$ compounds has been studied by EPR technique for x = 0.00, 0.20, 0.40, and 0.50. In the region of the absorption maximum the experimental spectra can be fitted to a lineshape function consisting of both Lorentzian absorption and dispersion components. Weiss constants, exchange fields, unbottle-necked g-shifts, and thermal broadening are calculated on the basis of the RKKY model and compared to the experimental results. The predicted Weiss constants and exchange fields are in good agreement with experiment, indicating the validity of the RKKY model. However, the predicted g-shifts and thermal broadening are much greater than those measured experimentally. The reduced g-shifts and thermal broadening are interpreted in terms of a magnetic resonance bottleneck, and

the relaxation rates due to the interaction of the conduction electrons with the localized moments and lattice are evaluated. (auth)

26420 LUMINESCENCE OF PRODUCTS OBTAINED BY PHOSPHIDING BORON NITRIDE. Klimak, Z. A.; Fainer, I. S. Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1041-1044(Jun 1975). (In Russian)

The luminescence of BN was studied and compared with that of samples subjected to phosphiding in a current of PH_3. The optical characteristics were correlated with the composition of the phosphided material as indicated by x-ray diffraction and chemical analysis. On phosphiding BN at 800 to 900°C for 1 to 4 h the resultant material constituted a multiphase system the principal component being BN; x-ray diffraction also revealed appreciable quantities of P_2O_5, BP and PON. The form of the photo-luminescence spectra of this material depended substantially on the phase composition. (Metals Abstr.)

26421 FAR-INFRARED REFLECTIVITY OF THE MIXED-VALENCE COMPOUNDS TmTe AND TmSe. Ward, R. W. (Simon Fraser Univ., Burnaby, British Columbia); Clayman, B. P.; Rice, T. M. Solid State Commun.; 17: No. 1, 1297-1300(15 Nov 1975).

Far-infrared reflectivity measurements have been made on the mixed-valence compounds TmTe and TmSe between 1.3 and 300°K. For TmTe at 1.3°K a single Reststrahlen band is observed at frequencies expected for divalent Tm in TmTe. At 4.2°K new weak structure appears which may be due to trivalent Tm. TmSe shows a surprisingly low reflectivity, but no phonon structure. The plasma edge is at ~10 cm^{-1} indicating a strongly frequency-dependent conductivity. (auth)

26422 PREDUPREZHDENIE VNEZAPNYKH VOSPLAMENENII POROSHKOV I VZRYVOV GAZODISPERSNYKH SISTEM. (Prevention of Sudden Ignition of Powders and Explosions of Gas-Dispersed Systems). Nedin, V. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). 218p.

Thirty-five articles are compiled on ignition of powders and explosions in gas-dispersed media. Separate abstracts were prepared for three of the articles. (JSR)

For abstracts of individual papers see: 26423, 26670, and 26671.

26423 COMBUSTIBILITY AND EXPLOSIVENESS OF LANTHANUM DICARBIDE AND CERIUM DICARBIDE POWDERS. Barlas, R. A.; Krivtsov, V. A.; Omel'chenko, E. V. pp 109-113 of Preduprezhdenie Vnezapnykh Vosplamenenii Poroshkov I Vzryvov Gazodispersnykh Sistem. Nedin, V. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The results of experimental studies on the flammability of lanthanum dicarbide and cerium dicarbide are discussed. The self-ignition temperature of the powders in layers and in suspension and the lower concentration limits for explosiveness were determined. The dependence of the explosion pressure and the pressure build-up rate on the concentration of the powder in suspension was obtained. (tr-auth)

26424 VITRIFICATION AND CRYSTALLIZATION IN TERNARY GERMANATE–LANTHANATE SYSTEMS WITH TANTALUM, HAFNIUM, AND ZIRCONIUM OXIDES. Gutkina, N. G.; Kozhina, I. I.; Shmatok, L. K. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 622-625(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 726-729(Apr 1975).

The investigated germanate–lanthanate systems with Ta, Hf, and Zr oxides have demixing regions, adjoining the GeO_2 vertex, crystallization fields of lanthanum pyro- and metagermanates, and the compounds $La_2O_3 \cdot Ta_2O_5$, $HfO_2 \cdot GeO_2$ and $ZrO_2 \cdot GeO_2$. Furthermore, the ternary system La_2O_3–Ta_2O_5–GeO_2 was found to contain an extensive region of $La_2O_3 \cdot 3Ta_2O_5$-based solid solutions and a stability region of an unidentified compound (presumably a ternary compound), adjoining the cross section of the system with ratio La_2O_3: Ta_2O_5 = 1. The vitrification regions are relatively small. In all three systems minimum crystallizability is exhibited by glasses, the compositions of which are located near the ternary peritectic. (auth)

26425 RELATIONSHIP BETWEEN THE STRUCTURE AND CONTROLLED FAILURE CHARACTERISTICS OF SOME HARD ALLOYS. Travushkin, G. G.; Chernyavskii, K. S.; Turchin, V. N. Strength Mater. (USSR) (Engl. Transl.); 7: No. 2, 240-243(Feb 1975).

Translated from Probl. Prochnosti; 7: No. 2, 105-107(Feb 1975).

Structural aspects of hard alloy failure under controlled conditions were investigated. Results show that in finding the weakest section in the structure of heterophase brittle materials, it is essential to carry out tests to destruction under controlled conditions, i.e. with slow crack propagation. Data have been obtained for the gradation of weak sections in the structure of a WC–20% Co alloy. It is shown to be possible to establish a correlation between the characteristics of the resistance to failure and a complex of stereological parameters of the structure. Rapid deformation may occur during crack propagation in a heterophase brittle material, and in consequence it is difficult to determine the failure mechanism from the form of the fracture. (auth)

26426 METALLOGRAPHIC STUDY OF THE NIOBIUM–HYDROGEN SYSTEM. I. β-Phase Room Temperature Morphologies. Schober, T.; Linke, U. (Kernforschungsanlage, Juelich, Ger.). J. Less-Common Met.; 44: 63-76(Jan 1976).

β-phase precipitation in the NbH system was investigated using optical metallography. Two β-phase morphologies were found: dendritic features at high supersaturations of hydrogen, and plates on $\{100\}_c$ at low supersaturations. The domain structure of the β-phase was investigated using polarized light techniques. The domains were thin plates, typically, a few μm thick, on low index planes of the matrix. A geometrical model of the β-phase domain structure was developed which is in good agreement with the experimental observations. The important role of coherent domain boundaries is discussed. β-phase crystals were found to cleave easily on $\{110\}_c$. Plastic slip induced slip lines on the surface of β-phase specimens which were compatible with $\{110\}_c$ slip planes. (auth)

26427 METALLOGRAPHIC STUDY OF THE NIOBIUM–HYDROGEN SYSTEM. II. γ, δ, ζ, and ε-Phase Precipitation. Schober, T.; Linke, U. (Kernforschungsanlage, Juelich, Ger.). J. Less-Common Met.; 44: 77-86(Jan 1976).

The observation of γ-phase precipitation in interference and polarized light contrast is reported. Characteristic surface deformation effects during the $\beta \rightarrow \gamma$ transformation are described. δ-phase precipitation was investigated in the concentration range from 100 to 200 at.% H/Nb. Precipitation occurred on $\{210\}_c$ planes. The accompanying bcc to fcc transformation led to strong plastic deformation in β-phase areas. ζ and ε precipitation did not affect the metallographic appearance of the β-phase domain structure. (auth)

26428 X-RAY STRUCTURE ANALYSIS OF BORON CARBIDE, $B_{13}C_2$. Will, G.; Kossobutzki, K. H. (Univ., Bonn). J. Less-Common Met.; 44: 87-97(Jan 1976).

The crystal structure of a boron carbide crystal of composition $B_{13}C_2$ has been determined and refined by x-ray diffraction to an R-factor of R = 4.3%. Six boron icosahedra are connected by C–B–C chains. In the icosahedra two types of boron atoms can be differentiated with 4.9 and 5.1 electrons/atom, respectively, depending on their bonding to adjacent icosahedral boron atoms or to carbon in the C–B–C chain. (auth)

26429 CRYSTAL STRUCTURE OF DILANTHANUM DIOXIDEDICARBIDE, $La_2O_2C_2$. Seiver, R. L.; Eick, H. A. (Michigan State Univ., East Lansing). J. Less-Common Met.; 44: 1-9 (Jan 1976).

The crystal structure of $La_2O_2C_2$ was determined from three dimensional x-ray diffraction data obtained with Mo radiation ($\lambda\alpha_1$ = 0.7093 Å) on a twinned crystal. The structure is of monoclinic symmetry, space group C/2m, with z = 2. Lattice parameters are, a = 7.069(8), b = 3.985(4), c = 7.310(9) Å, and β = 95.70(6)°; the calculated density is 5.41 g cm^{-3}. The twinning mechanism, a 120° rotation about c* or a slippage of the (001) cleavage plane, is explained in the light of the structural solution. Intensity data collected from each of the twinned fragments were merged for the final refinement, which yielded an unweighted discrepancy index, R, based on F, of 0.032. The lanthanum atom has four oxygen and four carbon atoms situated in a distorted bicapped trigonal prismatic arrangement. Interatomic La–O distances range from 2.392(8) to 2.823(9) Å and La–C distances from 2.86(1) to 3.11(1) Å. The carbon atoms are present at C_2 units with an interactomic C–C distance 1.21(3) Å. Oxygen atoms are tetrahedrally coordinated, as in the sesquioxide. (auth)

26430 PHASE RELATIONS AND THERMODYNAMICS OF REFRACTORY METAL PNICTIDES: THE ARSENIC DECOMPOSITION PRESSURES OF Mo_5As_4 AND ITS HEAT OF FORMATION. Murray, J. J.; Pottie, R. F.; Taylor, J. B. (National Research Council of Canada, Ottawa). J. Less-Common Met.; 44: 11-21(Jan 1976).

Arsenic pressures over Mo_5As_4 have been measured using the Knudsen effusion weight-loss method in the temperature range 1091 to 1506°K. The least-squares fitted equation, with standard deviation error limits, is log p(As_2,atm) = −17,465 ± 50/T + 8.3598 ± 0.0384. The second law $\Delta H^0_{T_{av}}$ and the estimated ΔH^0_{298} for the decomposition reaction are 79.9 ± 2.0 kcal and 84.3 ± 2.5 kcal per mole of $As_{2(g)}$, respectively, the errors being estimates of total errors. (auth)

26431 MAGNETIC PROPERTIES OF SOME RARE EARTH SILICIDES: GdSi, Gd_5Si_3, $Dy_{5-x}Nd_xSi_3$. Ganapathy, E. V.; Kugimiya, K.; Steinfink, H.; Tchernev, D. I. (Univ. of Texas, Austin). J. Less-Common Met.; 44: 245-258(Jan 1976).

The magnetic susceptibilities and magnetization behavior as functions of temperature and field strength were investigated for the compounds GdSi, Gd_5Si_3, and $Dy_{5-x}Nd_xSi_3$, $0 \le x \le 5$. The $1/\chi$ vs. T curves apparently indicate antiferromagnetic behavior but the Weiss temperature is always positive. The compounds have hexagonal structures and a series of interactions are postulated to exist among the magnetic atoms in the crystallographic sites. When these exchange integrals are substituted in the Heisenberg exchange Hamiltonian it is shown that the lowest energy spin configuration is a helical arrangement. It is concluded that, in general, an antiferromagnetic susceptibility behavior with a positive Weiss constant may be indicative of a helical spin arrangement. (auth)

26432 VITRIFICATION AND CRYSTALLIZATION IN TERNARY GERMANATE–LANTHANATE SYSTEMS WITH GALLIUM AND BORON OXIDES. Gutkina, N. G.; Kozhina, I. I.; Shmatok, L. K. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 619-621(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 721-725(Apr 1975).

The ternary germanate–lanthanate systems investigated have demixing regions which in the gallium system occupy a position near the GeO_2 vertex (from 85 to 100 mole % GeO_2), but in the boron system are located along the $GeO_2-B_2O_3$ side at an La_2O_3 content in the range from 1.5 to 15 mole %. In these systems the crystallization fields of $La_2O_3 \cdot 2GeO_2$, $La_2O_3 \cdot 3GeO_2$, $La_2O_3 \cdot 3B_2O_3$, $La_2O_3 \cdot B_2O_3$, Ga_2O_3, $xGa_2O_3 \cdot yGeO_2$, and of the two ternary compounds $xLa_2O_3 \cdot yGa_2O_3 \cdot zGeO_2$ and $xLa_2O_3 \cdot yB_2O_3 \cdot zGeO_2$ were determined. The crystal-optical and x-ray characteristics of the last three compounds and the crystal-optical characteristics of Ga_2O_3 were determined. Similarity is observed in the positions of the regions of vitrification of the gallium and boron systems, and in the positions of the crystal fields of $La_2O_3 \cdot 2GeO_2$ and the ternary compounds. (auth)

26433 INTERPRETATION OF THE MAGNETIC AND CRYSTAL-CHEMICAL PROPERTIES OF SOLID SOLUTIONS OF 2-3-4 GARNETS. Talanov, V. M.; Vorob'ev, Yu. P.; Selivanova, T. I.; Levchenko, V. M.; Men, A. N. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 598-601 (Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 695-699(Apr 1975).

The cluster-component method was used to interpret the concentration dependences a(c) and μ(c) of the solid solutions $\{Y_{3(1-c)}Ca_{3c}\}[M_{2c}Fe_{2(1-c)}](Fe_3)O_{12}$, where M = Zr^{4+}, Sn^{4+}, and $\{M^{3+}_{3(1-c)}CA_{3c}\}Fe_{5-3c}M^{4+}_{3c}O_{12}$, where $M^{3+} = Y^{3+}$, Gd^{3+}, and $M^{4+} = Si^{4+}$, Ge^{4+}. The calculated values of a(c) and μ(c) for these solid solutions agree with experiment. Magnetic moments are calculated and lattice parameters are estimated for the hypothetical components $\{Ca_3\}[Ge_2](Fe_2Ge)O_{12}$ and $\{Ca_3\}[Si_2](Fe_2Si)O_{12}$. It is shown that it is possible to calculate a(c) for one system from the known experimental results for a(c) for another differing in one of the cations in the dodecahedral sublattice. From the calculated values of λ(c) for the solid solution $\{Y_{3(1-c)}Ca_{3c}\}Fe_{5-3c}M^{4+}_{3c}O_{12}$, the curve of μ(c) is constructed for the solid solution $\{Gd_{3(1-c)}Ca_{3c}\}Fe_{5-3c}M^{4+}_{3c}O_{12}$. (auth)

26434 FORMATION, STABILITY, AND ELECTRICAL PROPERTIES OF FLUORITE-LIKE SOLID SOLUTIONS IN THE SYSTEM $ZrO_2-CaO-Y_2O_3$. Tikhonov, P. A.; Kuznetsov, A. K.; Keler, E. K.; Kravchinskaya, M. V. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 594-597(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 690-694(Apr 1975).

An investigation of the synthesis of fluorite-like solid solutions in the system $ZrO_2-CaO-Y_2O_3$ revealed formation of $CaZrO_3$ as an intermediate reaction product. Decomposition takes place by the eutectoid equilibria scheme and is not accompanied by segregation of $CaZrO_3$. Incorporation of Y_2O_3 into solid solutions of the system ZrO_2-CaO enables one to obtain cubic solid solutions stable at 1200-1400°C. The fluorite-like solid solutions in the system $ZrO_2-CaO-Y_2O_3$ are materials with relatively high resistivities; conduction is effected by movement of oxygen ions by a vacancy mechanism. (auth)

26435 STRUCTURAL CHARACTERISTICS AND RESIDUAL POLARIZATION OF NEODYMIUM NIOBATES. Zastavker, L. A.; Sych, A. M. (Kiev State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 580-583(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 674-678(Apr 1975).

Results of ir spectroscopic analysis show that in Nd_xNbO_3, which is of type ABO_3 with the preovskite structure, the neodymium atoms are statistically distributed in layers of the A sublattice which are only $\frac{2}{3}$ occupied. The possibility of creating residual charges on ceramic specimens of Nd_xNbO_3 and $NdNbO_4$ was established, the value of which is $(1-4) \cdot 10^{-3}$ C/cm^2. Residual polarization greatly changes the character of the temperature dependence of the conductivity σ and the dielectric losses tan δ of neodymium metaniobate and orthoniobate. (auth)

26436 SOLID SOLUTIONS IN THE SYSTEM HfO_2-CeO_2. Gavrish, A. M.; Zoz, E. I.; Gul'ko, N. V.; Solov'eva, A. E. (Scientific-Research Inst. of Refractories, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 574-576(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 668-670(Apr 1975).

X-ray phase and petrographic analysis revealed that the system HfO_2-CeO_2 contains monoclinic (on the HfO_2 side), tetragonal and cubic (on the CeO_2 side) solid solutions, between which regions of immiscibility are present. The concentration dependences of the unit cell constants and volume and the refractive indices of these solid solutions are given. (auth)

26437 OXYGEN ORDERING IN THE Zr–O ALLOY: A STRUCTURAL, CALORIMETRIC AND RESISTOMETRIC STUDY. Arai, T.; Hirabayashi, M. (Tohoku Univ., Sendai). J. Less-Common Met.; 44: 291-300(Jan 1976).

The ordered arrangement of oxygen atoms in a $ZrO_{0.18}$ crystal has been studied by neutron diffraction. Heat capacity and electrical resistivity were measured in order to reveal the order–disorder transformation of interstitial oxygen atoms over the range O/Zr = 0.16 to 0.40. It was found that the structure of ZrO_x is isomorphic with that of TiO_x, although the perfectly ordered distribution may not be attained in a realistic annealing time below $T_c \sim 300$°C. The transformation energy and entropy of ZrO_x have been determined to be about 300 cal/mol and 0.43 cal/mol deg, respectively. Anisotropic resistivity changes were observed on a single crystal of $ZrO_{0.39}$. A tentative phase diagram is proposed on the basis of the classical phase rule. (auth)

26438 DIFFUSION OF CARBON IN MOLYBDENUM TRIOXIDE. Pavlov, Yu. A.; Kryukov, S. N.; Sheboldaev, S. B.; Meshcheryakov, G. Ya. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 567-569(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 661-663(Apr 1975).

The radiometric method was used to determine the diffusion coefficient of ^{14}C in MoO_3 at 300-500°C, and the activation energy of this process was calculated. It is suggested that the diffusion coefficients at 400 and 450°C and the activation energies are somewhat too low, because at these temperatures the reduction of MoO_3 by carbon is rapid, distorting the diffusion distribution of the latter. (auth)

26439 THERMODYNAMIC CHARACTERISTICS OF VACANCIES IN ZIRCONIUM NITRIDE. Gusev, A. I.; Shveikin, G. P. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 561-563(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 653-656(Apr 1975).

An investigation was made of the effect of high-temperature vacuum sintering on the chemical composition of zirconium nitride. The electrical resistance of zirconium nitride was determined in the region of homogeneity. Certain thermodynamic parameters characterizing vacancy formation in the nitrogen sublattice in zirconium nitride were calculated. (auth)

26440 COLOR CENTERS IN SINGLE CRYSTALS OF CUBIC ZrO_2. Aleksandrov, V. I.; Barygov, S. Kh.; Voron'ko, Yu. K.; Denker, B. I.; Lomonova, E. E.; Osiko, V. V.; Tatarintsev, V. M. (Lebedev Inst. of Physics, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 570-573(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 664-667(Apr 1975).

In activated single crystals of cubic zirconium dioxide, the formation of color centers during γ irradiation and heat treatment is mainly due to capture of charge carriers by activator centers, and is governed by their nature. But the relative intrinsic radiation stability of the matrix is apparently governed by the shallow depth of most of the "intrinsic" capture levels in the forbidden zone. (auth)

26441 COLORATION AND LUMINESCENCE IN α-Al_2O_3 SINGLE CRYSTALS IRRADIATED WITH X-RAYS AT ROOM TEMPERATURE. Govinda, S. (Indian Inst. of Tech., Kharagpur). Phys. Status Solidi (a); 32: No. 2, K95-K100(16 Dec 1975).

The optical absorption and thermoluminescence of irradiated Al_2O_3 single crystals were measured. Data on the additional

optical density as function of wavelength for Al_2O_3 at different stages of x-ray coloration and at different stages of thermal bleaching are presented in plots. It is noted that further investigations are needed to define mechanisms of coloration and luminescence in Al_2O_3. (JRD)

26442 PHOTOVOLTAIC EFFECTS ON O^+ IMPLANTED GaAs. Deveaud, B. (Centre National d'Etudes des Telecommunications, Centre de Recherches de Lannion, France); Palmier, J. F.; Favennec, P. N.; Kar, R. K. Solid State Commun.; 17: No. 10, 1253-1255(15 Nov 1975).

Photovoltaic effects on O^+ implanted GaAs have been investigated. Spectral studies have shown the existence of two annealing stages associated with some complex. The first one at 300°C corresponds to its creation and the second one at 500°C to its annealing. A negative photo-effect is also observed. (auth)

26443 ELECTRICAL PROPERTIES OF ELECTRON- AND NEUTRON-IRRADIATED GALLIUM ARSENIDE. Kol'chenko, T.I.; Lomako, V.M. (V. I. Lenin Belorussian State University, Minsk). Sov. Phys.—Semicond. 9: No. 9, 1153-1154 (Sept 1975).

A study was made of changes in the electrical properties of GaAs doped with Te, S, Se, Si, Ge, Sn ($n_0 \simeq 10^{16} - 10^{18}$ cm^{-3}) and irradiated either with 2.5–28 MeV electrons or with fast reactor neutrons. An analysis of changes in the electron density indicated that the rate of carrier removal by electron bombardment was independent of the dopant but was governed by isolated radiation defects. The change in the mobility due to irradiation with 2.5–10 MeV electrons was also governed by isolated defects. When the electron energy was increased to 28 MeV the main contribution to the change in the mobility was made by defect clusters. In the neutron-irradiation case the changes in the carrier density and mobility were mainly due to defect clusters and the nature of changes in the electrical properties was again independent of the dopant. (auth)

26444 OBSERVATION OF ATHERMAL DEFECT ANNEALING IN GaP. Lang, D.V.; Kimerling, L.C. (Bell Laboratories, Murray Hill, New Jersey 07974). Appl. Phys. Lett. 28: No. 5, 248-250 (1 Mar 1976).

Capacitance spectroscopy studies of lattice defects intentionally introduced into GaP diodes by 1-MeV electron irradiation have shown a very large enhancement in the defect annealing rate under conditions of e-h recombination. Six deep levels are observed and all exhibit recombination enhanced annealing. Four of the levels anneal athermally during recombination having the same rate at 100 K as at 300 K. Comparisons of the thermal annealing activation energy and the energy released during hole capture indicate that the observed athermal enhancement is a natural consequence of the wide GaP band gap. (auth)

26445 ELECTRON TRAPPING BY RADIATION-INDUCED CHARGE IN MOS DEVICES. Aitken, J.M.; Young, D.R. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 47: No. 3, 1196-1198 (Mar 1976).

Electron trapping by positive charge centers induced in MOS structures by exposure to x rays has been studied by the avalanche injection technique. Five electron traps with cross sections ranging from 10^{-13} to 10^{-19} cm^2 have been measured. Two of these account for the majority of positive charge in the SiO_2 and the remaining three are associated with positive or neutral centers in the oxide. (auth)

26446 GENERATION LIFETIME INVESTIGATION OF ION-DAMAGE GETTERED SILICON USING MOS STRUCTURE. Nassibian, A.G.; Browne, V.A.; Perkins, K.D. (Allen Clark Research Centre, The Plessy Company Limited, Caswell, Towcester, Northants, England). J. Appl. Phys. 47: No. 3, 992-996 (Mar 1976).

Gettering of undesirable generation impurities by O and Ar implant damage layer has been investigated by transient response of MOS capacitors. One-half of each Si wafer was masked against the implanting ion beam and comparison was made between the two halves of each wafer by deducing the generation lifetime from the C-t measurements. The implant dosage was 10^{16} cm^{-2} and ion energy 200 keV. The gettering anneal at 1070°C was also the gate oxidation. The generation lifetime from 1–15 μs of the control half was increased to as high as 200 μs after both O and Ar implants. The results with O were more reproducible than with the Ar-implanted Si wafers; however, the largest increase in generation lifetime was observed with the Ar gettered wafer. It is proposed that there are generation centers other than the generation impurity centers that cannot be removed by gettering methods. (auth)

26447 RADIATION DEFECTS IN GaP BOMBARDED WITH 50 MeV ELECTRONS. Brailovskii, E.Yu.; Eritsyan, G.N.; Tartachnik, V.P. (Institute of Nuclear Research, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Phys.—Semicond. 9: No. 9, 1187-1188 (Sept 1975).

50 MeV electrons were used to bombard n-type GaP. The generation and annealing of defects were studied by measurements of the electric conductivity and Hall effect. (AIP)

26448 CHANGES IN Au-GaAs SCHOTTKY BARRIER DIODES WITH LOW NEUTRON FLUENCE. Borrego, J.M.; Gutmann, R.J. (Electrical and Systems Engineering Department, Rensselaer Polytechnic Institute, Troy, New York 12181). Appl. Phys. Lett. 28: No. 5, 280-282 (1 Mar 1976).

Guarded Au/n-GaAs Schottky barrier diodes fabricated from epitaxial and bulk material with carrier concentrations of 2.2×10^{16} and 7.8×10^{16} cm^{-3}, respectively, were exposed to fast neutron fluences between 3.6×10^{14} and 2.2×10^{15} neutron/cm^2. The forward I-V and 1-MHz C-V characteristics remained relatively unchanged after irradiation at the lower fluences where carrier compensation is small (reduction in carrier concentration less than 15%). However, the reverse current increased by more than one order of magnitude at room temperature, which is neither a result of surface leakage (prevented by the guarded device structures used), classical generation-recombination current (depletion volume changes are too small), nor thermionic emission (too weak a temperature dependence). This increase in reverse current is attributed to enhanced field emission from traps. (auth)

26449 METHOD FOR PREPARING ACTINIDE NITRIDES. Bryan, G. H.; Cleveland, J. M.; Heiple, C. R. (to U. S. Energy Research and Development Administration). US Patent 3,923,959. C01G56/00; C01G43/00; C01F15/00. 2 Dec 1975. Filed date 28 Nov 1973. 4p.

PAT-APPL-419,833.

Actinide nitrides, and particularly plutonium and uranium nitrides, are prepared by reacting an ammonia solution of an actinide compound with an ammonia solution of a reactant or reductant metal, to form finely divided actinide nitride precipitate which may then be appropriately separated from the solution. The actinide nitride precipitate is particularly suitable for forming nuclear fuels.

26450 METHOD FOR PREPARING THIN-WALLED CERAMIC ARTICLES OF CONFIGURATION. Holcombe, C. E.; Powell, G. L. (to U. S. Energy Research and Development Administration). US Patent 3,917,782. B29C5/02; B29C13/04. 4 Nov 1975. Filed date 16 May 1973. 4p.

PAT-APPL-361,000.

A method for preparing a hollow thin-walled ceramic product is described. Ceramic powder is plasma-sprayed onto a concave surface of a substrate having a coefficient of thermal expansion less than that of the ceramic. The coated substrate is heated to sinter the ceramic and then cooled to effect a separation of the ceramic product from the substrate. (auth)

26451 GRANULATION OF URANIUM OXIDE POWDERS. Georgeoni, P.; Deju, R. (Inst. for Nuclear Tech., Bucharest). Rev. Roum. Phys.; 20: No. 8, 855-862(1975).

Quality granules can be obtained by double granulation of uranium oxide briquettes. These granules can be used for the regular feeding of an automatic pelletizer with the assurance of good reproducibility of the density of the pellets (variation below ±0.25% of the average density). The granule spectrum is affected by the characteristics of the briquettes, the dimensions of the granulation cell, and the rotor speed. (tr-auth)

26452 STRUCTURAL CONDITIONS OF MAXIMUM PLASTICITY IN TWO-PHASE METALLIC MATERIALS. Movchan, B. A. (Inst. of Electric Welding, Kiev). Dokl. Akad. Nauk SSSR; 223: No. 2, 332-335(11 Jul 1975).

Samples in the form of sheet 120 × 200 and 0.8 to 1.2 mm thick were obtained by electron-beam evaporation and subsequent condensation of materials on a heated backing. The content of second phase in the sheet was varied from zero to 5 vol %, and the grain size of the metal matrix was varied by a factor of 10 by simultaneous evaporation from two different sources. The heating temperatures for the backing were equal to 600 and 1600°C respectively for iron and tungsten. Dispersed particles of NbC in the iron and of ZrO_2 in the tungsten were almost spherical in form and were randomly distributed in the matrix. Mechanical properties were determined by pulling the plane samples at a deformation rate of 0.1 min^{-1}. The average grain size D, the average path length between particles λ, the arbitrary yield point $\sigma_{0.2}$ and the rupture elongation in % were compared. A maximum in elongation at 0.07 to 0.10 vol % NbC in iron was observed under conditions where $D = \lambda$. The value of $\sigma_{0.2}$ as a function of the amount of second phase has an inflexion point at approximately $D = \lambda$. A maximum of plasticity is observed at 0.6 to 1.0 vol % ZrO_2 in tungsten at the corresponding condition where the grain size is equal to the path length between the particles ($D = \lambda$). The simultaneous evaporation and condensation of metallic and nonmetallic materials open up new vistas in the creation of optimum structures. (SJR)

26453 DYNAMICS OF THE CHANGE OF THE EXTERNAL ELECTRIC FIELD OF IRRADIATED PHOSPHATE GLASS. Zavadovskaya, E. K.; Starodubtsev, V. A.; Fedorov, B. V.; Kutukova, E. S. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 134-136(1975). (In Russian).

The process of increase of the size of the external electrical field of phosphate glass, charged in air by a fast electron current with a current density of 5×10^{-8} A/cm^2, is described by a relaxation relationship with time constant of the order of 2×10^2 s. The length of the relaxation time is determined by processes at the boundary of the glass with the surrounding medium. The direction of the dipole moment of the irradiated glass represents the localization of the injected charge close to the irradiated surface if the extrapolated mean free path of the electron is less than the thickness of the glass film. The size of the external electrical field at the level of saturation depends on the distribution of the injected electrons. (tr-auth)

26454 CHANGE OF THE INTENSITY OF THE EXTERNAL ELECTRIC FIELD OF A PHOSPHATE GLASS CHARGED BY AN ELECTRON CURRENT. Starodubtsev, V. A.; Fedorov, B. V. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 132-133(1975). (In Russian).

The dynamics of the change of the value of the external electric field above the irradiated surface of a aluminophosphate glass can be described by an equation of the type $y = 10^n \times e^{-mx}$, where x is the duration of the irradiation and y is the field intensity. The glass was exposed to an electron current of 3×10^{11} electrons/cm^2 s. The relaxation process for the decrease of the field intensity is characterized by a time constant of the order of 10 s. The value of the time constant can be caused by the radiation conductivity of the glass. (JSR)

26455 HIGH TEMPERATURE CORROSION BEHAVIOUR OF SiC AND Si_3N_4 IN BURNER GAS. Schlichting, J. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Chemische Technik). Werkst. Korros.; 26: No. 10, 753-758(Oct 1975). (In German).

The behavior of the materials has been studied in the following media: hot air (1,400°C), gaseous combustion products of CH_4, molten salts (Na_2SO_4, Na_2CO_3, NaCl) and molten vanadium pentoxide, combustion gases into which solutions of the above salts are injected (the specimens were heated to 1,200°C and then after a short cooling period sprayed with salt spray), combustion gases with addition of H_2S and HCl. In the salt melts SiC is rapidly destroyed under alkaline conditions while it is highly resistant to NaCl and V_2O_5. Material obtained by pyrolytic deposition from the gas phase is considerably more resistant than sintered material. The resistance is about the same for Si_3N_4. Generally the resistance is due to the formation of a vitreous layer on the ceramic surface. In the hot gases containing salt spray the materials are also highly resistant (super alloys tested under identical conditions are destroyed within a few hours while the ceramic materials show no trace of corrosion even after 200 hours). The influence of H_2S and HCl is very negligible. Materials having low porosity are superior to porous (e.g., sintered materials). (DE)

26456 THE ELECTROCHEMICAL BEHAVIOUR OF COPPER ALLOYS IN ARTIFICIAL SEAWATER AT 90°C. Altpeter, E.; Rockel, M. B.; Weidemann, R. (Vereinigte Deutsche Metallwerke A. G., Altena (F. R. Germany)). Werkst. Korros.; 26: No. 7, 529-537(1975). (In German).

In addition to practical corrosion tests in a test loop, electrochemical measurements on various Cu-Ni alloys were carried out. The alloys $CuNi_{10}Fe$, $CuNi_{30}Fe$, $CuNi_{30}Cr$, $CuNi_{30}Fe_2Mn_2$, $SoMs_{76}$, $CuNiAl_4$, $CuNiAl_{20}$, and $CuFe_2$ were investigated. The potentiokinetic E-i curves, current density-time curves and equilibrium rest potential curves were recorded. The alloys investigated can be well differentiated from the E-i curves. The passivation slope increases with the addition of Cr or Mn. A precorrosion of 500 h in seawater at 120°C displaced the equilibrium rest potential (corrosion potential) with all alloys to more positive values. A reduction of the potential change rate dE/dt clearly influences the break-through potential in parts and the current density in the passive region. Agreeing conclusions may be drawn from the potentiostatic testing, equilibrium rest potential-time curves and from the current density-potential curves. (DE)

26457 MEASUREMENT OF INTERNAL OXIDATION OF REACTION-BONDED SILICON NITRIDE DURING CREEP. Engel, W.; Porz, F.; Thuemmler, F. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Werkstoffkunde 2; Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Ber. Dtsch. Keram. Ges.; 52: No. 9, 296-299 (Sep 1975). (In German).

In a material of medium density (approximately 2.20 g/cm^3) the oxidation of reaction-bonded silicon nitride during creep is not only on the surface. Mean concentrations and concentration profiles of Si_2ON_2, cristobalite and β-Si_3N_4 over the cross-section of the specimen after being subjected to creep at different rates were measured by x-ray diffraction. In the tensile-stress areas of the specimens subjected to a flexural creep test, there were concentration maxima of Si_2ON_2 and β-Si_3N_4, possible reasons for which are given. Good resistance to creep under oxidizing conditions can only be expected if adequate textural stability is ensured, i.e., if internal oxidation is prevented. (DE)

26458 ELECTROCHEMICAL INVESTIGATIONS IN THE SYSTEM MANGANESE-TUNGSTEN-OXYGEN. Trumm, A. Munich; Univ., Munich (1971). 113p. (In German). INIS.

Thesis.

In the concentration triangle tungsten-manganese-oxygen, electrochemical partial pressure measurements were made. The oxygen partial pressure was determined via electromotive power generated by an oxygen-ion-conducting solid cell. Special attention was paid to the measurements in the intersection MnO-WO_3. The line of the oxygen partial pressure curve against the composition made it possible to demarcate the concentration area of a homogeneous nonstoichiometric mixture phase, which exists in this intersection. This area reaches 1,000°C from 40 mole % WO_3 to 50 mole % WO_3. At 700°C it appears to shrink to 40 mole %. (DE)

26459 CaO-STABILIZED ZIRCONIUM OXIDE FOR REFRACTORY PRODUCTS. Rehfeld, G. (Dynamit Nobel, A. G., Niederkassel-Luelsdorf (F. R. Germany)). Tech. Mitt.; 68: No. 6, 218-222(Jun 1975). (In German). (AED-CONF-75-299-001).

From conference on refractory building materials; Essen, F. R. Germany (19 Mar 1975). 10 figs.; 1 tab.; 12 refs.

The use of zirconium oxide in the manufacture of continuous casting nozzles is discussed. The deciding factors are the degree of stability of these zirconium oxides, the phase distribution cubic/monoclinic, as well as the processing method in manufacturing the nozzles. A share of CaO of 10 to 14 mol % is necessary to fully stabilize the zirconium oxide. The expansion behavior of monoclinic parts-stabilized and fully stabilized zirconium oxide differs which considerably influences the resistance to sudden temperature changes. The influence of this varying thermal behavior and the significance of the intermediate zones between the zirconium oxide grains are discussed. At present, microstructural investigations are being performed on continuous casting nozzles and investigations on the effect of impurities which for example, lead to partial-destabilization of the cubic zirconium oxide with a silicon dioxide content of more than 1%. (DE)

26460 ESR- AND MAGNETIC SUSCEPTIBILITY MEASUREMENTS ON THE POTASSIUM MOLYBDENUM BRONZES. Bang, G.; Sperlich, G. (Technische Univ. Darmstadt (F. R. Germany). Fachgebiet Experimentalphysik 2). Z. Phys., B; 22: No. 1, 1-12 (1975).

10 figs.; 3 tabs.; 38 refs. Part of a thesis by G. Bang.

Magnetic and transport properties of the transition metal bronzes are determined by the extent of delocalization of the transition metal 4d-electrons. ESR investigations of single crystals of the "red" potassium molybdenum bronze $K_{0.33}MoO_3$ and of the "blue" potassium molybdenum bronze $K_{0.30}MoO_3$ are reported on. ESR spectra due to unpaired d-electrons are observed at both compounds. Analyzing the hyperfine structure it was found that the d^1-electrons are delocalized over six molybdenum lattice sites in semiconducting $K_{0.33}MoO_3$. The same $K_{0.33}MoO_3$ crystal shows another spectrum which is caused by pairs of exchange coupled d-electrons. The results are compared with those from magnetic susceptibility measurements and are discussed in connection with the crystal structure of $K_{0.33}MoO_3$ and $K_{0.30}MoO_3$. (DE)

26461 A MODEL CALCULATION OF THE NEUTRAL MOLECULE EMISSION BY SPUTTERING PROCESSES. Gerhard, W. (Wuerzburg Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys., B; 22: No. 1, 31-39(1975).

4 figs.; 2 tabs.; 25 refs. Results of a thesis by the author.

Applying the principle conception of sputtering theory a calculation of the molecule emission yield in the energy range of the bombarding ions up to 1 keV is given. The possible molecule emission processes are discussed in detail in two specific cases: a calculation of the yield of diatomic and triatomic molecules containing equal atoms is performed; a rough estimation of the yield of diatomic molecules containing atoms of quite different masses is given. The comparison with experimental values of metal dimers, trimers, nitrides and oxides shows good agreement of the essential features as magnitude, energy and material dependence of the yield. (DE)

26462 $CuTa_2O_6$: CRYSTAL GROWTH AND CHARACTERIZATION. Longo, J. M. (Exxon Research and Engineering Co., Linden, NJ); Sleight, A. W. Mater. Res. Bull.; 10: No. 12, 1273-1277(Dec 1975).

The compound $CuTa_2O_6$ has been prepared as crystals from a Cu/O melt and found to be tetragonal (a equals 7.510 A, c equals 7.526 A) rather than cubic as reported in the literature. The coefficient of thermal expansion between room temperature and

1000°C was found to be 8.0 x 10^{-6} $°C^{-1}$. Electrical resistivity measurements on a crystal showed semiconductor behavior between room temperature (rho equals 2 x 10^3 OMEGA cm) and 140°K (rho equals 7 x 10^6 OMEGA cm) with an activation energy of E/sub A/ equals 0.2 eV. Magnetic measurements between 4.2°K and room temperature showed Curie–Weiss behavior with a change in mu eff at 120°K. For T greater than 120°K, mu eff equals 1.76 mu/sub B/ and theta/sub p/ equals 0°K while for T less than 120°K mu eff equals 1.91 mu/sub B/ and theta/sub p/ equals -15°K. (auth)

26463 STRUCTURE AND DIELECTRIC ANOMALIES IN $Tl_2Ta_2O_6$. Ganne, M.; Tournoux, M. (Laboratoire de Chimie Minerale B, Nantes, France). Mater. Res. Bull.; 10: No. 12, 1313-1318(Dec 1975).

Single crystals of the pyrochlore $Tl_2Ta_2O_6$ have been grown in a flux of thallous carbonate under pressure of carbon dioxide at 900°C. The crystal structure has been refined in the cubic space group Fd3m from 93 independent reflections. The problem of thallium localization along [111] axis is discussed. The dielectric properties show that the real space group cannot be Fd3m at temperatures less than 560°K. (auth)

26464 LIQUID PHASE EPITAXY OF $LiNgO_3$ THIN FILMS FOR INTEGRATED OPTICS. Baudrant, A.; Vial, H.; Daval, J. (Laboratoire de Cristallogenese, Grenoble, France). Mater. Res. Bull.; 10: No. 12, 1373-1378(Dec 1975).

$LiNbO_3$ thin films have been obtained by liquid phase epitaxy from a Li_2O–V_2O_5 flux. Phase diagram, supersaturation domain, and growth conditions have been investigated. The propagation of light has been demonstrated in an Ag substituted $LiNbO_3$ film grown on a vector c plate $LiNbO_3$ substrate. (auth)

26465 BORON-CONTAINING METALLIC MATERIALS. Serole, B.; Devin, P.; Beaudouin, P. (to Compagnie pour l'Etude et la Realisation de Combustibles Atomiques (CERCA), 75–Paris (France)). French Patent 2,231,764/A/. 30 May 1973. 9p. (In French)

Description is given of a method for manufacturing boron-containing metal products or a boron-containing substance, and a metallic substance. This method is characterized in that the metallic substance and the boron-containing substance are in powdered form, these powders being mixed, compressed and sintered so as to form a block with two sides connected as a lateral surface. (FR)

26466 A METHOD FOR COATING NUCLEAR-FUEL PARTICLES. Morin, C. (Compagnie pour l'Etude et la Realisation de Combustibles Atomiques (CERCA), 75–Paris (France)). (to CEA, 75–Paris (France)). French Patent 2,231,078/A/. 25 May 1973. 6p. (In French)

Description is given of a method for manufacturing coated nuclear fuel particles for high temperature reactors, said method comprising feeding fuel-particles at the top of a fluidization furnace and submitting same to an upward flow of at least one inert gas and at least one pyro-cracking gas at a temperature of from 1,000 to 3,000°C. Pressure within the furnace is regulated at between 1 and 20 absolute bars. The thus coated particles are used in high temperature reactors. (FR)

26467 CONTROLLED POROSITY INSULATING CERAMICS AND A METHOD FOR MANUFACTURING SAME BY SINTERING. Carbonnel, H.; Chaminade, F. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92–Le Plessis-Robinson (France)). French Patent 2,229,663/A/. 18 May 1973. 6p. (In French)

An industrial preparation method is described consisting in mixing crushed grains with a finely divided powder of oxides of groups IIa, IIb, IVb, metals of the periodic table, then sintering that mixture at moderate temperature in the presence of a fluoride. The porosity of the ceramics thus obtained varies in proportion to the grain/powder ratio. This can be applied to liquid metal pumps. (FR)

26468 COMPARISON OF SOLIDIFICATION TEMPERATURES OF DIFFERENT RARE EARTH SESQUIOXIDES; EFFECT OF ATMOSPHERE. Coutures, J. P.; Verges, R.; Foex, M. (Centre National de la Recherche Scientifique, 66–Montlouis (France). Lab. des Ultra-Refractaires). Rev. Int. Hautes Temp. Refract.; 12: No. 2, 181-185(Apr 1975). (In French)

From 4th European conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

The measurement of the solidification point of the rare earth sesquioxides shows anomalies for La_2O_3, Gd_2O_3, Lu_2O_3 and allows to find the well known ceric group and yttric group. The effects of the atmosphere on the refractory character are generally low. An interpretation in order to explain the observed changes, is proposed. (FR)

26469 ON THE CONDUCTIVITY OF ZrO_2-CeO_2 SYSTEM. Chappey, B.; Gouet, M.; Guillou, M. (Paris-12 Univ., 94–Creteil (France)); Auclair, B. (Dakar Univ. (Senegal)). C. R. Hebd. Seances Acad. Sci., Ser. C.; 280: No. 17, 1053-1056(5 May 1975). (In French)

In order to determine the conductivity of binary zirconium oxide-cerium oxide balanced with pure oxygen and air within the 700-1500°C range, the overall conductivity measurement and the transfer number have been coupled. (FR)

26470 NATURE OF ELECTRICAL CONDUCTIVITY AT ELEVATED TEMPERATURES IN THE ZIRCONIUM OXIDE-SAMARIUM OXIDE BINARY SYSTEM. Gouet, M.; Chappey, B.; Guillou, M. (Paris-12 Univ., 94–Creteil (France)). C. R. Hebd. Seances Acad. Sci., Ser. C; 280: No. 18, 1117-1119(12 May 1975). (In French)

Samarium oxide added to zirconium oxide releases a lacunar cubic phase whose major electrical conductivity is rendered ionic for low Sm_2O_3 ratios. A n-type electronic conductivity is therefore evidenced. (FR)

26471 L_{β_1} BANDS OF THE METAL IN COMPOUNDS OF NIOBIUM WITH BORON, CARBON, AND NITROGEN OF STOICHIOMETRIC COMPOSITION. Korsunskii, M. I.; Genkin, Ya. E.; Lifshits, V. G. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 61-64(1974). (In Russian).

The L_{β_1} bands of the metal in Nb_3B_2, NbB, Nb_3B_4, Nb_2C, NbC, Nb_2N, and NbN were obtained and processed in accordance with the KLO model. It was shown that the character of the change of the form of the long-wave part of the band in compounds of stoichiometric composition confirms the assumptions of the model that in spectra of metal-like compounds electron states appear causing local metal–metalloid bonds. (tr-auth)

26472 ANNEALING STUDIES OF FISSION DAMAGES IN MUSCOVITE. Lal, N.; Nagpaul, K. K. (Kurukshetra Univ., India). Indian J. Phys.; 49: No. 9, 637-641(Sep 1975).

Arrhenius plots of fission damages in muscovite were plotted under laboratory conditions and the data have been extrapolated to geologically significant times and temperatures. Fossil fission tracks in muscovite will start fading if it remained at ~60°C for 1000 m.y. whereas in the same period, all the tracks will be annealed at a temperature of ~160°C. The activation energy of fission damages in the mineral ranges from 1.4 to 1.8 eV. (auth)

26473 FULLY ION IMPLANTED INTEGRATED CIRCUIT PROCESS. Perkins, K. D.; Walsh, P. S.; Ward, P. J. (Plessey Co., Ltd., Towcester, Eng.). pp 113-114 of Solid State Circuits Conference: ESSCIRC. London; Institution of Electrical Engineers (1975).

From 1st European solid state circuits conference: ESSCIRC; Canterbury, Eng. (2 Sep 1975).

The availability of ion implantation as a means of introducing dopant into semiconductors at low temperature with a close control on doping level has opened up a new range of technology and circuit design flexibility. A process is described in which all the dopant atoms are introduced by ion implantation with subsequent annealing treatment to establish electrical activity and correct junction depths. The introduction of the buried n^+ layer by implantation has led to close control on the collector region of the transistors, an area which has been neglected in many previous processes. Transistor breakdown voltages and the high frequency performance of the modern transistor are intimately connected with the collector region. Close control on the base (boron) and the emitter (arsenic) doping levels has enabled narrow-base width transistors to be fabricated with adequate production control so that high f_T can be achieved consistently. Typical f_T versus collector current behavior is shown. The process has been designed for minimal high temperature treatments. To this end the conventional collector sink and isolation diffusions have been omitted and their function is performed by the emitter and resistor diffusions respectively. To achieve the required depth of these junctions from the surface, the regions around the transistor have been etched away forming a mesa for each transistor. An added benefit of this structure is that the base of the transistor is bounded by oxide, leading to a reduction in the collector-base junction area. Since ion implantation is a low temperature deposition process, photoresist masking has been used. This leads to a further reduction in high temperature processes. The characteristics of several types of circuits fabricated by this process are reported. (auth)

26474 MAGNETISM IN NEPTUNIUM BORIDES. Smith, J. L.; Hill, H. H. pp 382-383 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Magnetization measurements were performed on NpB_2, NpB_4, and NpB_{12} over the temperature range 2 to 180°K. NpB_2 is ferromagnetic below T/sub c/ equals 99.5 +- 2°K; NpB_4 antiferromagnetic below T/sub N/ equals 52.5 +- 2°K. These compounds exhibit approximate Curie–Weiss behavior above their ordering temperature. The corresponding Pu compounds as well as PuB_6 were found not to exhibit magnetic ordering greater than 2°K. The susceptibility of NpB_{12} is relatively independent of temperature. Attempts to prepare NpB_6 in the arc furnace were unsuccessful. The ferromagnetism of NpB_2 is apparently itinerant in nature, the moment being unsaturable at 52 kOe and 2°K and having magnitude approximately 0.3 mu/sub B//Np atom. The very occurrence of magnetism in the compound is somewhat surprising considering the relatively small separation between nearest-neighbor Np atoms in the compound, d/sub Np-Np/ equals 3.16 A. (Metals Abstr.)

26475 REACTION OF ZIRCONIA WITH METALS. Meshalkina, N. V.; Strakhov, V. I.; Akselrod, L. M. (Lensovet Technological Inst., Leningrad). Refractories (USSR) (Engl. Transl.); 16: No. 1-2, 50-52(1975).

Translated from Ogneupory; 16: No. 1, 51-53(Jan 1975).

An investigation was carried out of the resistance of stabilized ZrO_2 to the action of molten Fe, Cr, Ni, Al, and steel grades St. 3 and 1Kh18N9T in vacuo and in a reducing medium. The degree of impregnation with the melts is lower for products fabricated from unstabilized ZrO_2 than for the other investigated refractories. Among the solid solutions of ZrO_2 with a stabilizer the metal resistance was highest for the products molded from the cubic solid solution $ZrO_3-Nd_2O_3$. The nature of the reaction of Cr and steel grade 1Kh18N9T with ZrO_2 stabilized with CeO_2 and Nd_2O_3 consists of partial destabilization of the ZrO_2 in the contact zone as a result of the formation of chromites of the rare-earth elements. No crystalline regeneration occurred in the reactions with the other molten metals and steel grade St. 3. The product of the reaction of these agents with ZrO_2 stabilized with CaO, Nd_2O_3, or CeO_2 was a vitreous phase rich in the oxide of the metal concerned.

26476 MULTILAYER STRUCTURE OF TANTALUM ANODIC OXIDE FILMS FORMED IN DILUTE PHOSPHORIC ACID. Kihara-Morishita, H. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Thin Solid Films; 29: No. 2, 211-215(Oct 1975).

An investigation was made of the multilayer structure of anodic oxide films on pure tantalum, formed up to various voltages with a constant current density of 1.0 mA cm^{-2} in 1.0×10^{-2} N H_3PO_4 at 20°C. For the study, infrared reflectance spectra (IRRS) were recorded and the optical thickness measuring method was successfully applied using the wavelengths of optical interference maxima and a chemical film stripper (concentrated ammonium hydrogen difluoride aqueous solution). The conclusions are that: (1) tantalum anodic oxide films anodized in dilute phosphoric acid consist of three layers, irrespective of the formation voltage; (2) the innermost layer is uniform whatever the anodization voltage; (3) phosphate anions are incorporated in both the outermost and middle layers but not in the innermost layer; (4) all three layers grow from the initial formation stage and the growth rates are nearly equal; (5) for formation voltages below 100 V the middle layer has an unchanging chemical structure, but above 100 V its chemical structure changes with the voltage; (6) the outermost layer appears to vary in chemical structure over all anodization voltages (auth)

26477 SOLID-PHASE FORMATION REACTION OF $BaNb_2O_6$. Gorislavskii, V. I.; Kisel, N. G.; Nikiforov, L. G.; Shuvalov, V. V.; Chuprova, G. K. (Inst. of Aviation Engineering, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 894-896(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1049-1052(Jun 1975).

Using thermographic, x-ray phase, and chemical analysis the solid-phase reaction of $BaCO_3$ with Nb_2O_5 (at 1:1 molar ratio of the components) was investigated. It was found that formation of $BaNb_2O_6$ is preceded by that of $BaNb_{0.8}O_3$. Barium carbonate decomposes into BaO and CO_2 very rapidly in the presence of Nb_2O_5 as early as 700°C, whereas the BaO formed combines with niobium pentoxide at an appreciable rate only at much higher temperatures.

26478 TERNARY SYSTEM $Na_2WO_4-K_2WO_4-WO_3$. Drobasheva, T. I.; Bogodukhova, N. A.; Rabkina, I. G. (Inst. of Civil Engineering, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 900-902(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1056-1059(Jun 1975).

Various different physicochemical analysis methods were used to show that the ternary system $Na_2WO_4-K_2WO_4-WO_3$ contains continuous solid solutions $Na_2(K_2)WO_4$ and $Na_2(K_2)W_4O_{13}$ and three new compounds $3Na_2WO_4 \cdot 9K_2WO_4 \cdot 8WO_3$, $12Na_2WO_4 \cdot K_2WO_4 \cdot 12WO_3$, and $11Na_2WO_4 \cdot 7K_2WO_4 \cdot 7WO_3$. The ternary eutectic point of the system $Na_2WO_4-K_2WO_4-WO_3$ has a temperature of 520°C, which is nearly 200° below the melting point of Na_2WO_4.

26479 CHANGE IN THE LATTICE CONSTANT OF ZIRCONIUM CARBIDE IN THE REGION OF HOMOGENEITY. Mitrokhin, V. A.; Lyutikov, R. A.; Yurkova, R. S. Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 978-980(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1144-1146(Jun 1975).

Derivation of an equation for the lattice constant (a) of zirconium carbide containing various different impurity contents is reported. The equation can be used to analyze carbides containing no metallic impurity atoms. The equation is applicable for $0.62 \leq x \leq 0.30$ and $y \leq 0.30$ where x is the atomic ratio C/Zr and y is the atomic ratio (O + N)/Zr. The derived equation is: ZrCx (On)y = $4.5621 - 0.2080x^2 + 0.3418x - 0.80y(1 - x)$. (JRD)

26480 MAGNETIC SUSCEPTIBILITY AND ELECTRICAL RESISTANCE OF THE SOLID SOLUTIONS ZrN–NbC. Gusec, A. I.; Dubrovskaya, L. B.; Shveikin, G. P. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 981-982(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1147-1148(Jun 1975).

The magnetic susceptibility and electric conductivity of stoichiometric ZrN– NbC solid solutions were investigated. The electric conductivity was found to decrease linearly with temperature increase indicating that these solid solutions have metallic type conductivity. The temperature coefficient of magnetic susceptibility is negative; its value varies only slightly with composition changes. (JRD)

26481 PHASE COMPOSITION AND PHASE DIAGRAM OF THE SYSTEM $V_2O_5-CsV_2O_5$. Surat, L. L.; Fotiev, A. A.; Volkov, V. L. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 983-984(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1149-1150(Jun 1975).

The phase composition of the system $V_2O_5-CsV_2O_5$ was investigated and a phase diagram of this system in an inert atmosphere was constructed. A phase diagram is included along with tabulated x-ray data on compounds in the system. (JRD)

26482 THERMOCHEMICAL INVESTIGATION OF CERIUM ORTHOFERRITE. Kesler, Ya. A.; Sorokin, V. V.; Tret'yakov, Yu. D. (Moscow State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 985-986(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1151-1152(Jun 1975).

The enthalpy of formation of $CeFeO_3$ was determined from data on its heat of oxidation. The standard enthalpy of formation value was formed to be ΔH_{298} $CeFeO_3 = -16.62 \pm 0.46$ kcal/mole. (JRD)

26483 EFFECT OF MODIFIERS ON THE STRUCTURE OF YTTRIUM OXIDE CERAMIC. Belousenko, A. P.; Spivak, I. I.; Vyskrebtsev, V. P.; Velina, O. F.; Lazarenko, V. D. Refractories (USSR) (Engl. Transl.); 16: No. 1-2, 53-56(1975).

Translated from Ogneupory; 16: No. 1, 53-57(Jan 1975).

The structure of ceramics processed from Y_2O_3 alone and with added oxides of Zr or Th were analyzed. It was found that the structure-forming process of yttrium oxide ceramic is influenced by the addition of small amounts of the high-melting oxides of zirconium and thorium. (JRD)

26484 SYSTEM $Eu_2O_3-Gd_2O_3-Ta_2O_5$ AT Ta_2O_5 CONTENTS OF 25, 50, AND 75 MOLE %. Ustimovich, A. B.; Pinaeva, M. M.; Kuznetsova, V. V.; Shul'man, L. D.; Sleptsov, S. E. (Inst. of Physics, Minsk). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 897-899(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1053-1055(Jun 1975).

Using x-ray, electron-microscopic, and luminescence methods, cross sections of the system $Eu_2O_3-Gd_2O_3-Ta_2O_5$ at Ta_2O_5 concentrations of 25.50, and 75 mole % were investigated. The unit cell parameters of the phases $(Eu_xGd_{1-x})_3TaO_7$, $Eu_xGd_{1-x}Ta_3O_9$, and $Eu_xGd_{1-x}TaO_4$ of the quasi-binary systems were calculated on the basis of cubic (fluorite type), orthorhombic (perovskite type), and monoclinic (fergusonite type) structures respectively. The existence of solid solutions based on cubic, monoclinic, and orthorhombic structural types respectively throughout the range of values of x were established. The variation of the unit-cell parameters does not obey Vegard's law. Anomalies in their variation with an increase in x are observed near x values of 0.15 and 0.35. (JRD)

26485 POLYMORPHISM OF U_3O_8. Tsvigunov, A. N.; Kuznetsov, L. M. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 859-862 (1974).

Translated from Radiokhimiya, 16: No. 6, 882-885(1974).

The hydrothermal synthesis of single crystals of the high-temperature modifications α'-U_3O_8 and α''-U_3O_8 is described. It

was established that the stabilization of α'-U_3O_8 occurred as a result of the introduction of lithium ions into the U_3O_8 lattice. From data from the study of the single crystals, the parameters of the elementary cell of α'-U_3O_8 and the possible Fedorov groups were determined. (auth)

26486 NATURE OF PARAMAGNETIC CENTERS IN HEXAGONAL BORON NITRIDE. Khusidman, M. B. Sov. Radiochem. (Engl. Transl.); 16: No. 6, 893-894(1974).

Translated from Radiokhimiya; 16: No. 6, 916-918(1974).

The results of a detailed analysis of the EPR spectra arising from the interaction of an unpaired electron with three ^{11}B nuclei (spin 3/2) and one ^{13}C nucleus with different constants for the interaction of these nuclei are presented. The data indicated, but necessary calculations to provide definitive support were not carried out, that the paramagnetic centers were due not to a nitrogen vacancy but to a carbon atom vacancy. Available data on reflective spectra of hexagonal BN powder, luminescence spectra, and excitation spectra lend support to this explanation. However, a detailed theoretical calculation of the HFS is needed to confirm the models selected from theoretical interpretation of modes selected for the paramagnetic centers. (BLM)

26487 LOW TEMPERATURE MAGNETIC PHASE TRANSITION IN TmSe. Ott, H. R.; Andres, K.; Bucher, E. pp 40-41 of Magnetism and Magentic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The magnetically ordered state of TmSe less than 3^0K was investigated by means of thermal expansion and magnetostriction measurements (down to 1.5^0K and up to 15 kOe) as well as by ac susceptibility measurements in different magnetic fields. From these data it is possible to construct a diagram of the magnetic phases at low temperature. The ordering is antiferromagnetic in nature but three distinctly different phases were found below the Neel temperature T/sub N/. The Neel temperature remains constant in external magnetic fields up to 5 kOe. For higher fields an unambiguous interpretation of the experimental features is difficult. (Metals Abstr.)

26488 FISSION FRAGMENT DAMAGE IN ZIRCON. Vance, E. R. (Australian National Univ., Canberra); Boland, J. N. Radiat. Eff.; 26: No. 3, 135-139(Oct 1975).

X-ray diffraction, electron microscope and optical studies have been made on zircons damaged by fission fragments derived from the action of neutrons on uranium impurities in the zircon lattice. A dosage of about 10^{14} fission events $\cdot$ cm^{-3} was required to produce diffuse x-ray scattering, observable by conventional photographic methods, and a dosage of about 10^{16} fission events $\cdot$ cm^{-3} appears to be required to render a zircon amorphous. An optical absorption band, generated apparently by γ-rays, was observed near 270 nm in undoped zircon. The valence state of the uranium impurities was unchanged by irradiation with 10^{14} fission events $\cdot$ cm^{-3}, 2×10^{18} nvt of fast neutrons, or $\sim 10^{10}$ R of γ-rays. A fission event in zircon was deduced to produce $\sim 10^4$ times more displacement damage than an α-recoil atom. Individual fission tracks were observed directly by electron microscopy after dosage of 10^{10} to 10^{13} fission events $\cdot$ cm^{-3}, the tracks being similar in appearance to those found by other workers in other materials. With increasing dosage, fission fragment irradiation appears to produce a progressive disordering of the lattice, as was previously deduced for the case of α-recoil irradiation, rather than the formation of new crystallographic phases. (auth)

26489 ACCUMULATION OF COLOR CENTERS IN PHOSPHATE GLASSES DURING IRRADIATION WITH ELECTRONS. Zausaeva, N. N.; Nizkii, S. E.; Starodubtsev, V. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 57-63(1975). (In Russian).

In optical absorption spectra, individual bands of gaussian form are separated out by means of a computer, and their parameters were determined. An increase in concentration of color centers of two types with an increase in the integral electron flux was calculated from the formula of Smakula. Two stages were identified in the kinetics of color center accumulation. The concentration of color centers of 3.0 and 2.4 eV are linearly related to each other. Composition of the irradiated phosphate glasses varied from 30% CaO-70% P_2O_5 to 30% CaO-5% Al_2O_3-65% P_2O_5, and finally to a composition of 10% CaO-25% Al_2O_3-65% P_2O_5. (SJR)

26490 EFFECTS OF PROTON BOMBARDMENT TO [ON] n-TYPE GALLIUM ARSENIDE. Sakurai, T.; Bamba, Y.; Furuya, T. Fujitsu Sci. Tech. J.; 11: No. 2, 71-80(Jun 1975).

Isolation effects due to the proton bombardment of n-type GaAs have been studied. Bombardment with 150 keV protons at doses of 3×10^{12}/cm^2 is necessary to produce high resistivity layers the initial carrier concentration of which is $1-3 \times 10^{16}$/cm^3. For proton doses $>6 \times 10^{12}$/cm^2, the high resistivity layers are stable against annealing at 435°C. The thickness of the high resistivity layer is ~0.85 μm/100 keV of proton energy. (Metals Abstr.)

26491 MODEL CALCULATIONS OF MEAN-SQUARE ATOMIC DISPLACEMENTS FOR TaC, HfC, AND ZrC. Feldman, J. L. (Naval Research Lab., Washington, DC). Phys. Rev., B; 12: No. 2, 813-814(15 Jul 1975).

Results of model calculations of the temperature dependences of the mean-square atomic displacements are reported for TaC, HfC, and ZrC. Weber's models, which yield good agreement with available neutron data, were employed.

26492 PREPARATION AND PROPERTIES OF MONOCRYSTALLINE Pr_2O_3. Lejus, A. M. (CECM, Vitry sur Seine, France); Collongues, R.; Bernier, J. C. J. Solid State Chem.; 15: No. 4, 370(Dec 1975). (In French).

Single crystals of praseodymium oxide with hexagonal A structure were prepared by the Verneuil process. Paramagnetic susceptibility measurements have been performed for various orientations of the crystal with respect to the magnetic field at constant temperatures (5, 77, 300^0K) as well as at increasing temperatures (5 to 1000^0K). They show an exceptional magnetic anisotropy (chi perpendicular/chi parallel approximately equal to 12 at 5^0K). An interpretation of this phenomenon is proposed.

26493 OXYGEN VACANCIES IN $Nb_{22}O$/sub 54 - x/, $Nb_{25}O$/sub 62 - x/, AND $Nb_{28}O$/sub 70 - x/. Kikuchi, T.; Goto, M. (Inst. for Researches in Inorganic Materials, Ibaraki, Japan). J. Solid State Chem.; 15: No. 4, 371(Dec 1975).

The isolated oxygen vacancies in $Nb_{22}O$/sub 54 - x/, $Nb_{25}O$/sub 62 - x/, and $Nb_{28}O$/sub 70 - x/ at temperatures above 1300^0C were examined thermodynamically using gravimetric data obtained previously by Kimura. The concentration of oxygen vacancies in $Nb_{22}O$/sub 54 - x/ and $Nb_{25}O$/sub 62 - x/ was estimated from isothermal changes in weight and found to be proportional to Po_2/sup -1/4/. With $Nb_{28}O$/sub 70 - x/, on the other hand, the concentration of oxygen vacancies was proportional to Po_2/sup -1/4/. These results can be explained well on the assumption that the main defects, which all depend upon the partial pressure of oxygen in the surrounding atmosphere, are oxygen vacancies with one trapped electron, quasifree electrons, and tetravalent niobium atoms.

26494 PREPARATION AND INVESTIGATION OF RARE EARTH ANTIMONATES $Ln_2Ln'SbO_7$(Ln, Ln' EQUALS Lu, Y, Gd, OR Ga) WITH THE AID OF Eu^{+3} DOPING. Faurie, J. P.; Boulon, G.; Delaigue, M. C. (Universite de Clermont-Ferrand, France). J. Solid State Chem.; 15: No. 4, 372(Dec 1975). (In French).

Rare-earth antimonates $Ln_2Ln'SbO_7$(Ln, Ln' equals Lu, Y, Gd, or Ga) have been prepared with pyrochlore structure. Excitation and emission spectra of these host lattices doped with Eu^{3+}, reveal two sites for Ln^{3+} and Ln'^{3+}. The symmetry of these sites is not D/sub 3d/ as in the pyrochlore structure but could be C/sub 3v/.

26495 NEUTRON DIFFRACTION DETERMINATION OF THE CRYSTAL STRUCTURE OF Ce_7O_{12}. Ray, S. P. (Columbia Univ., New York, NY); Cox, D. E. J. Solid State Chem.; 15: No. 4, 333-343(Dec 1975).

A neutron diffraction study has been made on polycrystalline and single crystal samples of $CeO_{1.714}$. The results confirm that the compound is isostructural with ternary oxides of the type UY_6O_{12}. The space group is R anti 3 with hexagonal unit cell dimensions a equals 10.37 A and c equals 9.67 A (rhombohedral cell a equals 8.60 A and alpha equals 99.4^0). The hexagonal unit cell contains three formula units of Ce_7O_{12}. Totals of 79 and 24 independent reflections from the single crystal were measured at neutron wavelengths of 1.185 and 2.37 A, respectively. Simultaneous refinement of the two sets of data yielded a weighted R factor of 0.144. The structure is a rhombohedral defect type of fluorite arrangement in which pairs of oxygen vacancies are ordered along the [111] axis.

26496 X-RAY AND NEUTRON DIFFRACTION STUDY OF INTERMEDIATE PHASES IN NONSTOICHIOMETRIC CERIUM DIOXIDE. Ray, S. P. (Columbia Univ., New York, NY); Nowick, A. S.; Cox, D. E. J. Solid State Chem.; 15: No. 4, 344-351(Dec 1975).

Powder samples of reduced ceria, CeO/sub 2 - x/, of known compositions in the range 0 less than x less than 0.3 have been examined by x-ray and neutron diffraction techniques in order to determine which intermediate phases belonging to the homologous series Ce/sub n/O/sub 2n - 2/ (with n equals integer) truly exist. Through the appearance of superlattice lines in the neutron diffraction patterns, the existence of four distinct phases, corresponding to n equals 7, 9, 10, and 11 was established. Aside from the phase Ce_7O_{12}, the structures of these phases cannot be accounted

for with rhombohedral cells based on (111) vacancy strings, but indicate lower (monoclinic or triclinic) symmetry. The structure of Ce_9O_{16} and $Ce_{10}O_{18}$ do not agree with structures proposed for the analogous Pr/sub n/O/sub 2n - 2/ compounds.

26497 FIRST PRINCIPLES CALCULATIONS OF LOCAL PROPERTIES OF SOLIDS. Byrom, E. Chicago; Northwestern Univ. (1975). 168p. University Microfilms Order No. 75-29,593.

Thesis (Ph. D.).

This thesis explores a cluster model, through calculations in the Hartree–Fock–Slater (HFS) approximation, by the Discrete Variation Method. The HFS equations are solved in a model potential, generated from a sum of free atom or ion charge densities. The potential due to the crystal outside the cluster is included in the model potentials, and as a fixed exterior potential when the cluster solution is iterated to self consistency. In metal clusters, problems associated with charge transfer between the cluster and the bulk of the crystal are examined. For magnetic systems, spin unrestricted calculations are made. The eigenvalues are compared to band theory energy levels and experimental spectra. From the eigenfunctions charge and spin densities are calculated, with particular attention to Moessbauer isomer shifts; neutron scattering form factors, and transferred hyperfine fields. The magnetic semiconductors EuO and EuS are treated, the former in a self-consistent field calculation. The differing covalent effects at the two inequivalent Fe sites in YIG are examined. The metallic system studied is beta'-NiAl, both the pure alloy and transition metal impurities within it. (Diss. Abstr. Int., B)

26498 EFFECT OF LOCAL EXCITATIONS ON PHONON TRANSPORT PROPERTIES. Ecsedy, D. J. Storrs, CT; Univ. of Connecticut (1975). 122p. University Microfilms Order No. 76-1667.

Thesis (Ph. D.).

At low temperatures, the thermal conductivity is limited by boundary scattering. As the temperature is increased the conductivity goes through a maximum and then gradually declines. The mechanisms responsible for the increase in resistivity are reviewed: (i) Three-phonon U-processes yield an exponential dependence at low and intermediate temperatures and a T^1 dependence at temperatures near the Debye temperature. (ii) Strong point defects modify the high temperature dependence to T/sup 1/2/. (iii) Platelets generally lead to a slower than T^1 dependence. Four-phonon processes are considered as a special case of general multi-phonon interaction theory. An inverse relaxation time as a function of the first two Grueneisen parameters is derived. The thermal expansion is considered as a mechanism contributing a T^2 component to the resistivity. The thermal conductivity of an expanded crystal is expressed in powers of the dilatation where the leading term is the conductivity of the unexpanded crystal. The conductivity for a number of simple nonmetallic crystals (KCl, Al_2O_3, BeO, MgO) at constant volume was calculated. Thermal expansion is an important mechanism in high temperature thermal conductivity. At temperatures intermediate to the low temperature exponential region and the high temperature T^{-1} region for three-phonon U-processes there is no analytic solution. A form for the conductivity containing elements of both the high and low temperature forms is proposed for practical calculations at intermediate temperatures. Low-temperature (1K – 5K) thermal conductivity results for fluorapatite are presented. An estimate of the value and the temperature of the conductivity peak is made. (Diss. Abstr. Int., B)

26499 ELECTRON-NUCLEAR DOUBLE-RESONANCE INVESTIGATIONS OF V/sub OD/ CENTERS IN CaO. Abraham, M. M. (Oak Ridge National Lab., TN); Chen, Y.; Unruh, W. P. Phys. Rev., B; 12: No. 11, 4766-4770(1 Dec 1975).

Single crystals of CaO doped with deuterium have been grown by the submerged-arc-fusion method and V/sub OD/ centers were produced by gamma irradiation at 77°K. EPR and electron-nuclear double-resonance measurements yield the following spin Hamiltonian parameters: g/sub parallel/ equals 2.0020(2), g/sub perpendicular/ equals 2.0730(2), A/sub parallel/ equals +0.423(1) MHz, A/sub perpendicular/ equals -0.212(1) MHz, and P equals +0.188(1) MHz. Relative signs were obtained experimentally and the assignment of the absolute signs follows from the assumption of a positive dipolar interaction of the hole with the reported positive deuterium nuclear moment. The magnetic hyperfine interaction is essentially all dipolar and implies a slight outward (100) relaxation of the axial oxygens. The measured electric field gradient at the deuteron is compared with the corresponding case in MgO and with other substitutional-impurity trapped-hole centers in the cubic oxides. (auth)

26500 CREEP OF LOW-DENSITY YTTRIA/RARE EARTH-STABILIZED ZIRCONIA. Seltzer, M. S. (Battelle-Columbus Labs., OH); Talty, P. K. pp 297-312 of Deformation of Ceramic Materials. Bradt, R. C.; Tressler, R. E. (Eds.). New York; Plenum Press (1975).

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974). See CONF-740724-.

Constant-stress compression creep experiments were performed on low-density yttria/rare earth-stabilized zirconia (YRESZ) containing 12.5 and 14.5 percent Y_2O_3. Major microstructural modifications which occur in these materials at high temperature serve to increase creep strength without increasing the overall density. The constitutive equations describing steady-state creep behavior of low-density YRESZ all contain a stress component n approximately 3.2 and a creep activation energy Q/sub c/ approximately 128 kcal/mole. The pre-exponential structure factors vary with thermal history. 11 figures. (auth)

26501 TRANSFORMATION PLASTICITY AND HOT PRESSING. Chaklader, A. C. D. (Univ. of British Columbia, Vancouver). pp 425-442 of Deformation of Ceramic Materials. Bradt, R. C.; Tressler, R. E. (Eds.). New York; Plenum Press (1975).

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974). See CONF-740724-.

The transformation plasticity during the phase transition of quartz to cristobalite, monoclinic reversible tetragonal of zirconia, metakaolin to a spinel phase, and brucite to periclase was investigated by studying their compaction characteristics. Viscous flow was found to be the predominant mechanism of mass transport (after an initial particle rearrangement stage) in the case of quartz to cristobalite phase change where the transformation was associated with the formation of an intermediate amorphous silica phase. The results on the monoclinic reversible tetragonal transformation of zirconia indicated that it is most likely controlled by internal strain induced by the stress associated with the volume change (DELTAV/V) and the flow stress of the weaker phase. Particle movement and deformation of the weaker phase (possibly tetragonal) may be the manifestation of this plasticity. The plasticity in the case of metakaolin to a spinel phase appeared to start before the exothermic reaction (generally encountered in a dta plot) and may be diffusion controlled. The plasticity encountered during brucite to periclase transformation may be the combined effect of disintegration of precursor particles, vapor-phase lubrication and some deformability of freshly formed very fine MgO particles. (auth)

26502 TRANSFORMATIONAL SUPERPLASTICITY IN PURE Bi_2O_3 AND THE Bi_2O_3–Sm_2O_3 EUTECTOID SYSTEM. Johnson, C. A. (General Electric Co., Schenectady, NY); Smyth, J. R.; Bradt, R. C.; Hoke, J. H. pp 443-453 of Deformation of Ceramic Materials. Bradt, R. C.; Tressler, R. E. (Eds.). New York; Plenum Press (1975).

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974). See CONF-740724-.

Results for Bi_2O_3 and the Bi_2O_3–Sm_2O_3 eutectoid show that ceramics can exhibit superplasticity analogous to that of metals. Results are in tentative agreement with the Greenwood and Johnson theory, but additional criteria must be met for ceramics to exhibit transformational superplasticity, a large transformational volume change to induce large internal stresses and the occurrence of the transformation at T/T/sub mp/ greater than or equal to 0.75. It is suggested that the process is a grain boundary sliding mechanism. (DLC)

Metals and Alloys

Refer also to abstracts 25822 and 28036.

26503 (UCRL-50028-75-2) H-DIVISION QUARTERLY REPORT, APRIL–JUNE 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-Eng-48. 58p. Dep. NTIS $5.45.

A separate abstract was prepared for each of the seven sections for ERDA Energy Research Abstracts (ERA). In addition, six sections were abstracted for NSA. (RCK)

For abstracts of individual sections see: 25737, 25880, 25930, and 26615–26617.

26504 STRUCTURES OF THE ELEMENTS. Donohue, J. New York; John Wiley and Sons, Inc. (1974). 444p. $22.50.

Descriptions of the structures of all elements through Bk in the solid state are presented. Information and data are included on lattice constants, positional parameters, interatomic distances, and where appropriate, bond and torsion angles. A bibliography is also included covering the literature through 1972. (JRD)

26505 ETCHING OF THE (111) PLANES OF InSb AND SOME OF THEIR PROPERTIES. Mazurkevich, Ya. S.; Zozulya, N. I.; Kostyuk, L. S.; Zozulya, Yu. I. (Chernovtsy State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 4, 525-529(Apr 1975).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 11: No. 4, 611-616(Apr 1975).

A study was made of the etching of single crystals of InSb by compositions based on the oxidants HNO_3, H_2O_2, and $FeCl_3$, and also mixtures of HNO_3 and H_2O_2. Rates and activation energies of etching of the polar planes were determined. The (111) and ($\bar{1}\bar{1}\bar{1}$) surfaces have different reactivities, different catalytic activities in the reduction of methylene blue, and different contact potential differences. The values of these parameters are correlated; this is due to the structures and chemical bonding in these compounds.

26506 CREEP AND FATIGUE IN ELEVATED TEMPERATURE APPLICATIONS. Volume I, Proceedings of Conferences of the American Society of Mechanical Engineers and American Society for Testing Materials held in Philadelphia, 23-27 September 1973, and in Sheffield, 1-5 April 1974. New York; Mechanical Engineering Publications (1975). vp. (CONF-730916-P1; CONF-7404121-P1).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

Seventy-nine papers were presented at the conference. A separate abstract was prepared for each of twenty-seven papers. Twenty-seven papers are announced in Nuclear Science Abstracts and seven papers are announced in ERDA Energy Research Abstracts. (JRD)

For abstracts of individual papers see: 26562, 26748-26771, 26812, and 26813.

26507 CREEP AND FATIGUE IN ELEVATED TEMPERATURE APPLICATIONS. Volume II. Proceedings of Conferences of the American Society of Mechanical Engineers and American Society for Testing Materials Held in Philadelphia, 23-27 September 1973, and in Sheffield, 1-5 April 1974. New York; Mechanical Engineering Publications (1975). 109p. (CONF-730916-P2; CONF-7404121-P2).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

Keynote lectures presented at the conference on properties of materials in relation to design and modern codes, and design aspects of elevated temperature technology are included in the volume. Summaries of discussions during the seven sessions of the conference are also presented. (JRD)

Corrosion and Erosion

Refer also to abstracts 26121, 27996, 27997, 28023, 28044, 28045, 28054, 28127, 28184, and 28197.

26508 (AED-CONF-74-538-040) METALLURGICAL FEATURES AND CORROSION RESISTANCE OF AUSTENITIC WELD OVERLAYS BY THE SUBMERGED-ARC STRIP PROCESS. Thier, H.; Adam, W. 1974. 7p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

Available from ZAED.

Alloy element loss and gain, metallurgical features of the flux, dilution as a function of welding parameters, preliminary calculation of chemical composition and ferrite content, intergranular corrosions, time-temperature sensitivity diagrams, and stabilization by niobium and post-weld heat-treatment are discussed. (DE)

26509 (CRN-CNPA-75-15) MOESSBAUER STUDY OF ^{151}Eu IN HYDROGEN-LOADED PALLADIUM. Meyer, M.; Friedt, J. M.; Iannarella, L.; Danon, J. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 8p. INIS.

The decrease of the ^{151}Eu isomer shift on hydrogenation of a dilute EuPd (2.5 at. % Eu) alloy is discussed in terms of the volume effect on the charge density at the nucleus. (FR)

26510 (WAPD-TM-1203) ANALYSIS OF IODINE STRESS CORROSION CRACKING OF ZIRCALOY-4 TUBING. Kreyns, P. H.; Spahr, G. L.; McCauley, J. E. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Feb 1976. Contract E(36-1)-GEN-14. 31p. Dep. NTIS $4.00.

A fracture mechanics approach to interpreting iodine-vapor stress-corrosion cracking (SCC) in unirradiated Zircaloy-4 tubing is presented in which crack velocities are related to the fourth power on the stress intensity factor, K/sub I/. The crack growth power law on K/sub I/ is shown to predict well the time-to-failure in internally pressurized Zircaloy-4 tubing at 360 and 400°C reported by Busby, Tucker and McCauley. The temperature dependency on iodine stress corrosion cracking in Zircaloy can be described by an Arrhenius-type equation in which the activation energy Q for recrystallized and cold-reduced Zircaloy was determined to be 42.9 kcal/mole and 35.9 kcal/mole, respectively. It is concluded that the geometry of the initial surface flaw, through its attendant elastic stress field, is directly responsible in controlling the SCC time-to-failure, cold working having a relatively small effect on increasing the susceptibility to SCC. Any effects of the fast neutron flux on iodine stress corrosion cracking of Zircaloy-4 tubing either in-reactor or out-of-pile are still unknown.

26511 SYSTEMATIC STUDY OF THE REACTION DYNAMICS OF ALUMINUM, THORIUM, GROUP IVA AND VA METAL-OXYGEN ACTIVE COMBUSTION SYSTEMS. Maloney, K. M. (General Electric Co., Cleveland). J. Less-Common Met.; 44: 141-154(Jan 1976).

The measured burning rates vs. oxygen pressure of Al, Th, Group IVA and VA metals, are found to exhibit the same characteristic behavior. This is shown to result from the fact that the reaction dynamics are diffusion-limited. The single-strand technique is shown to enable observation of the heretofore unresolved inner-flame zone. The marked difference between Al and the other systems studied, is clearly demonstrated, and related to the occurrence of superheating. In addition, heat conduction in these high-temperature, active combustion systems is shown to be inadequately explained on the basis of a conventional Fickian analysis. (auth)

26512 CORROSION OF MOLYBDENUM AND TUNGSTEN IN LIQUID SODIUM. Barker, M. G.; Morris, C. W. (Univ., Nottingham, Eng.). J. Less-Common Met.; 44: 169-176(Jan 1976).

The corrosion of molybdenum and tungsten has been examined in static and dynamic liquid sodium. Corrosion of molybdenum was not found to be oxygen dependent; no ternary oxide corrosion products were observed. Inclusion of labile carbon into the system containing molybdenum caused the formation of molybdenum carbide, Mo_2C, which was identified by its powder x-ray diffraction pattern. The corrosion of tungsten was found to be strongly influenced by the initial concentration of dissolved oxygen in the liquid metal; at low oxygen levels in the dynamic system the cubic phase, Na_2WO_4(a_o = 4.62 Å), was identified by its x-ray diffraction pattern recorded through a matrix of sodium, whereas, at initially very high oxygen levels in static systems, the orthorhombic phase, Na_4WO_5, was identified. The solid-state interaction of sodium oxide with molybdenum and tungsten metals under vacuum give the ternary phases Na_4MoO_5 and Na_4WO_5, respectively, together with unreacted refractory metal and sodium vapor. (auth)

26513 HYDROGEN IN Ti-V ALLOYS. Korn, C. (Ben Gurion Univ. of the Negev, Beersheba, Israel); Zamir, D.; Hadari, Z.; Teitel, D. Phys. Status Solidi (a); 32: No. 2, K147-K150(16 Dec 1975).

Nuclear magnetic resonance traces of H in Ti-V alloys were obtained. These traces show that the addition of vanadium to titanium offers of different type of local environment for hydrogen and that hydrogen associated with vanadium sites diffuses more readily. When a small concentration of hydrogen is dissolved, it prefers to accumulate in regions associated with vanadium over a pure titanium environment. (auth)

26514 DEVELOPING THE LASER CORROSION MONITOR. Tozer, B. A. (Central Electricity Generating Board, Southampton, Eng.). Phys. Technol.; 6: No. 6, 251-257(Nov 1975).

An account is given of development of a laser corrosion monitor used to measure oxide thicknesses from ten to several hundred micrometers on various nuclear reactor components. The monitor uses a free running ruby laser, water-cooled to keep its temperature below 20°C, in a water-cooled container together with a helium-neon laser and auxiliary equipment. The design of the monitor, trials at Hinkley Point, small batch production, the present state of development and future developments are discussed. (UK)

26515 KORROZIYA I ZASHCHITA METALLOV. (Corrosion and Protection of Metals). Gritsenko, E. E. (ed.). Kiev; Naukova Dumka (1972). 128p.

Thirty articles on new processes and the theory of fast annealing are compiled. The technology for the deposition of new polymer coatings is examined. Data are given on the corrosion stability of construction materials in melts containing aggressive chloride compounds. Data are also given on the electrochemical behavior of Mo, Ti, and other metals during anodic polarization of solutions of chromium sulfate. The electrodeposition of corrosion-resistant In-Sb and magnetic Co-Ni-P alloys is also discussed. Separate abstracts were prepared for six articles. (tr-auth)

For abstracts of individual papers see: 26516-26521.

26516 GALVANIC INDIUM–ANTIMONY COATINGS. Bespal'ko, O. P.; Vdovenko, I. D. pp 10-14 of Korroziya i Zashchita Metallov. Gritsenko, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian)

An electrolytic method is described for the production of indium–antimony coatings of varying composition. Data are presented on the corrosion resistance of these coatings in vacuum oil at temperatures of 35 to 140°C. (tr-auth)

26517 STUDY OF THE CORROSION RESISTANCE OF A NUMBER OF CONSTRUCTION MATERIAL IN A MOLTEN SALT MELT OF $AlCl_3$–NaCl. I. Chetverikov, A. V.; Korchinskaya, O. A. pp 37-41 of Korroziya i Zashchita Metallov. Gritsenko, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian)

The corrosion resistance of Mo, Al, Ni, Pb, Ti, steel 08KP and stainless steel 1Cr18Ni9T was investigated by measuring the loss of sample weight in a melt containing 2 moles of $AlCl_3$ and 1 mole of NaCl at a temperature of 200°C. Molybdenum was found to be the most resistant metal. A less detailed study on corundum, an enamel frit for steel, a fluoresin and a strengthened glass showed that corundum was the most resistant material. (tr-auth)

26518 STUDY OF THE CORROSION RESISTANCE OF A NUMBER OF CONSTRUCTION MATERIALS IN A MOLTEN SALT MELT OF $AlCl_3$–NaCl. II. Chetverikov, A. V.; Zhigailo, A. Ya.; Korchinskaya, O. A. pp 41-44 of Korroziya i Zashchita Metallov. Gritsenko, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian)

Prolonged corrosion tests were carried out on the most suitable construction metals under conditions of complete immersion of the sample in the $AlCl_3$–NaCl salt melt and also at the boundary separating the melt from the gas (air). According to decreasing corrosion stability the metals under test can be arranged in the series: Mo, Al, Pb. (tr-auth)

26519 EFFECT OF CERIUM AND BORON ADDITIVES ON THE CORROSION PROPERTIES OF STAINLESS STEEL Cr18Ni9T. Lisogor, A. I.; Bogacheva, N. A. pp 58-63 of Korroziya i Zashchita Metallov. Gritsenko, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian)

By gravimetric and potentiometric methods, a study was made of the effect of various amounts of Ce and B modifiers on the corrosion properties of stainless steel Cr18Ni9T in solutions of sulfuric and hydrochloric acids. It is shown that the addition of boron increases the corrosion stability of the stainless steel. Modifying the stainless steel with cerium in amounts of 0.1 to 0.6% and also the combined treatment of the stainless steel with Ce and B decreases the corrosion resistance in solutions of the acids which were investigated. (tr-auth)

26520 ANODIC BEHAVIOR OF MOLYBDENUM, TUNGSTEN, TANTALUM, AND TITANIUM IN SOLUTIONS OF CHROMIC SULFATE. Antonov, S. P.; Zosimovich, D. P.; Stepanenko, V. G. pp 89-92 of Korroziya i Zashchita Metallov. Gritsenko, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian)

Confirmation was obtained of the possibility of oxidizing chromic ions on molybdenum, tungsten, tantalum and titanium anodes, and a study was made of the rate of the anodic passivation of these metals in the presence of other competing processes (the oxidation of chromium or the precipitation of lead dioxide). (tr-auth)

26521 STUDY OF POLARIZATION DURING THE ELECTRODEPOSITION OF TUNGSTEN ALONG WITH NICKEL. Vas'ko, A. T.; Shaturskaya, V. P.; Ermolenko, V. I. pp 92-98 of Korroziya i Zashchita Metallov. Gritsenko, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian)

A study was made of the effect of hydrogen peroxide, ammonium sulfate, boric acid and temperature on the cathode polarization during the electrodeposition of tungsten along with nickel from an acidic, peroxide electrolyte. (tr-auth)

26522 PRECIPITATION IN COMMERCIAL B- AND Si-CONTAINING NICROCOAT COATINGS. Fitzer, E.; Maeurer, H. J.; Schlichting, J. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Chemische Technik). Z. Metallkd.; 66: No. 10, 565-569(Oct 1975). (In German).

The chemical and diffusion behavior between commercially available NICROCOAT-coatings and several iron metals and their alloys was studied by electron probe analysis. It was found that TiB_2-additions to the coating material react with the chromium content and Cr_2B is precipitated if minimum Cr-content between 18 and 23 wt % is present in the diffusion zone. In this case the worse oxidation resistance at high temperatures can be explained. If the coating layer contains $TiSi_2$ no formation of a Si-phase was found because of the solubility of Si in the Ni/Cr-matrix. In this case the increased oxidation resistance is based on the additional contribution of the silicon to the protective layer. (DE)

26523 BEHANDLUNG VON METALLOBERFLAECHEN FUER DEN KORROSIONSSCHUTZ DURCH ANORGANISCHE SCHICHTEN. Begriffe. (Treatment of Metallic Surfaces for Corrosion Protection by Inorganic Layers. Definitions). Berlin, F. R. Germany; Beuth (Jul 1975). 6p. (In German). (DIN-50902).

This standard defines terms concerning the treatment of metallic surfaces for corrosion protection by inorganic layers including preparatory treatment. Those terms which are used in the same sense in other standards are assigned with the respective standard number. There is a compilation of other standards dealing with terms in the field of surface, manufacturing process and corrosion protection. (DE)

26524 DIFFUSION OF HELIUM IN A SILVER-LITHIUM-ALLOY AFTER NEUTRON IRRADIATION. Mirus, K. D. Berlin; Technische Univ., Berlin (1973). 90p. (In German). INIS. Thesis.

A helium concentration of 1.1×10^{-5} at.% was produced in Li-doped silver by the nuclear reaction Li-6(n,T)He-4. In post-activation diffusion tests, the noble gas production was measured continuously using a mass spectrometer in a static vacuum system at 410 to 809°C. The isothermal kinetics can be satisfactorily described by the assumption of simultaneous processes of diffusion and capture in traps with vanishing emission probability as stated by Gauss. In accordance with this assumption, the rate of degasification (F) shows an initial rise of $t^{\frac{1}{2}}$. Diffusion coefficients were determined from this initial region. Owing to the permanent capture, the maximum rate of degasification (F_{max}) remains smaller as 1 and increases with increasing temperature, reduced thickness of the probe, and decreasing neutron dose. After maximum degasification below 700°C, further degasification could be observed above 700°C. (DE)

26525 CORROSION OF STEELS IN CO_2. Proceedings of the British Nuclear Energy Society International Conference Held at Reading, England, September 23–24, 1974. Holmes, D. R.; Hill, R. B.; Wyatt, L. M. (eds.). London; British Nuclear Energy Society (1974). 395p. (CONF-7409139-).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974).

Thirty one papers were presented, in sessions entitled mild steel (kinetics); mild steel (mechanisms); 9 Cr steels (kinetics and mechanisms); austenitic steels (kinetics and mechanisms, fuel cladding, design implications). All the papers were in NSA scope and separate abstracts were prepared for each. (UK)

For abstracts of individual papers see: 26526–26556.

26526 OXIDATION KINETICS OF CARBON STEELS IN PRESSURISED CO_2-BASED ATMOSPHERES AT ELEVATED TEMPERATURES. German, P. A.; Littlejohn, A. C. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). pp 1-14 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Information produced between 1957 and 1974 in the laboratories of the companies engaged in design and construction of gas cooled reactors is summarized. The range of experimental conditions covered is temperature, 573 to 823°K; pressure, 1.48 to 5.27 MN/m^2; carbon monoxide content, 0 to 5% and water content, 2 to 1,000 ppM by volume. Test durations range from a few thousand hours up to 95,000 hours. The oxidation rates observed within this range of variables are between 5×10^{-4} $\mu g/cm^2/h$ and 1×10^2 $\mu g/cm^2/h$. The main features of the kinetic data and oxide film structure are discussed for the three stages of oxidation generally observed on carbon steels; sequentially, these are the protective, transitional, and non-protective. Relationships between oxidation rate constants and other parameters have been derived over limited ranges of variables. The protective rate constants have shown a broad correlation with temperature, while the non-protective rate constants show relationships with the silicon content of the steel, the temperature, and the water vapor pressure in the gas. The duration of the protective oxidation behavior is influenced by silicon content, surface roughness, temperature, the presence of carbon monoxide, and the water vapor pressure in the gas. The type of film breakdown observed is determined predominantly by the silicon content and the temperature. (auth)

26527 MULTIVARIABLE INVESTIGATION OF THE KINETICS OF OXIDATION OF MILD STEELS IN HIGH TEMPERATURE CO_2. Ferguson, J. M. (Central Electricity Research Labs., Leatherhead, Eng.); Garrett, J. C. P.; Lloyd, B. pp 15-27 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The kinetics of oxidation of mild steel in CO_2 in the temperature range 633 to 770°K were studied over a range of water and CO concentrations at gas pressures of 1.48 and 2.85 MNm^{-2}. The parameters examined were the protective oxidation rate, the time to initiation of breakaway and the post breakaway corrosion rate. A multiple linear regression analysis was used to obtain an equation to describe the effects of environmental and material variables on the post breakaway rate. The activation energy for breakaway corrosion was found to be ~72 kJ mol^{-1} at water concentrations below 25 wt ppM in the temperature range 770 to 633°K but a higher activation energy of ~130 kJ mol^{-1} was found at water levels ≥100 wt ppM at temperatures <750°K. The transition temperature between the two regimes appears to be a function of water concentration. Graphitic paint coatings had a considerable effect in reducing the time to breakaway but had no effect on the final breakaway rate. Silicon in the steel was advantageous in increasing the duration of the protective regime and in reducing the final post breakaway rate. (auth)

26528 "ELECTRICTE DE FRANCE" WORK ON THE MILD STEEL CO_2 CORROSION PROBLEM. Donati, J. R. (Etudes et Recherches, Moret s/Loing, France); Garaud, J. pp 28-41 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Results are presented of CO_2 corrosion tests carried out: (a) in the laboratory (at 390 and 430°C, 41 bar, 250 vol ppM H_2O), on 14 grades of mild and low alloy steels; (b) in the Saint Laurent 1 reactor (at 400°C, 26 bar, 60 to 80 vol ppM H_2O), on assemblies of various rimming and silicon-killed mild steels. Conclusions are drawn regarding the influence on the corrosion of the chemical composition and the structure of the steels, as well as of the temperature and water content of the gas. (auth)

26529 CORROSION OF UNALLOYED OR LOW-ALLOYED STEELS IN PRESSURIZED CARBON DIOXIDE. Dewanckel, B. (CEN, Fontenay-aux-Roses, France); Leclercq, D.; Dixmier, J. pp 42-44 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The corrosion of unalloyed or low-alloyed steels by carbon dioxide from 375 up to 440°C has been extensively investigated by the CEA, in connection with the graphite-gas reactor system. The present duration of some tests extends to 50,000 hours. Results are given which concern mostly commercial steels, though sometimes special experimental casts have been used. A tentative synthesis of the data shows the influence of several factors which are associated either with the materials or with their operating conditions. (auth)

26530 STEEL CORROSION EXPERIENCE IN THE LATINA REACTOR. Camona, G. A. (Centro International Studi Esperienze, Milan); Imbergamo, M.; Ronchetti, C. pp 45-53 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

A statistical study is being carried out in connection with the Latina Power Station Reactor surveillance program on bolts of the most critical reactor cage assemblies. The tests are made in autoclaves with pure CO_2 at 13 kg/cm^2, elongation up to failure of bolts being checked. To accelerate tests, many washers were packed to increase the number of interfaces and three testing temperatures were adopted, 390, 420, and 500°C. At the same time studies are being performed on the corrosion of steels with different silicon contents and differing surface treatments. The experimental apparatus also permits the acquisition of data on oxide growth kinetics both on free surfaces and interfaces, on oxide-to-metal volume ratios, and on the effects of temperature on corrosion kinetics. (auth)

26531 PROTECTIVE AND BREAKAWAY CORROSION OF MILD STEEL IN CO_2. Gibbs, G. B.; Pendlebury, R. E.; Wootton, M. R. (Central Electricity Generating Board, Berkeley, Eng.). pp 59-72 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Oxidation of mild and low alloy steels in high pressure carbon dioxide at temperatures in the range 653 to 773°K is initially protective. The oxidation rate decreases with increasing time according to an approximately parabolic rate law. However, after an incubation period there may be a transition to faster linear breakaway kinetics. The microstructural changes which are an essential feature of the protective-breakaway transition have been studied in detail on laboratory samples and on specimens removed from Magnox reactors, and a model proposed for oxidation in high pressure gas. In the protective stage of growth a compact scale is first formed by outward diffusion of metal ions. This injects lattice vacancies into the substrate, some of which condense to give loss of scale-metal adhesion. In these regions the protective oxide develops microporosity and an inner layer nucleates and grows. Continuing protective oxidation produces a duplex structure, the inner layer growing in the volume made available by metal departing to form new outer oxide. Microporosity is maintained by a buildup of carbon monoxide at the scale-metal interface, which also regulates the growth of the inner layer. Breakaway oxidation is rapid inner layer growth which occurs when the carbon monoxide is destroyed locally by a catalyzed carbon deposition reaction. (auth)

26532 INVESTIGATIONS INTO THE MECHANISM OF BREAKAWAY OXIDATION OF THREE MILD STEELS IN HIGH PRESSURE CO_2 AT 500°C. Pritchard, A. M.; Antill, J. E.; Cottell, K. R. J.; Peakall, K. A.; Truswell, A. E. (United Kingdom Atomic Energy Authority Research Group, Harwell, Eng.). pp 73-84 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The oxidation behavior of three mild steels in high pressure CO_2 at 500°C, and in particular the protective-to-breakaway transition facilitated by the presence of water vapor, have been studied. The stresses developed in the scale during this process have been measured and were large enough to cause failure of the scale. The proportion of carbon deposited in the scale during oxidation via the Boudouard reaction, $2CO \rightleftharpoons CO_2 + C$, increased with scale thickness and the water content of the gas, and was higher in breakaway oxide. The presence of sulfur in the metal reduced the carbon uptake in the metal and the oxidation rate, but did not affect the proportion of carbon in the scale. Most of the carbon was deposited in the scale at or near the scale/metal interface in both protective and breakaway oxide, showing that the scales had cracks or micorpores. No evidence was found for extensive carburization of the metal, and carbon deposition is not considered to initiate breakaway, though it may propagate it. Analyses of tritium uptakes in coupons exposed to T_2O/CO_2 mixtures show that significant quantities of hydrogen accumulate at the scale/metal interface and it is proposed that breakaway oxidation is initiated by hydrogen by a mechanism which has yet to be identified conclusively. (auth)

26533 ROLE OF CARBON IN THE BREAKAWAY OXIDATION OF MILD STEEL IN HIGH PRESSURE CARBON DIOXIDE. Surman, P. L.; Brown, A. M. (Central Electricity Research Labs., Leatherhead, Eng.). pp 85-96 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The rate controlling step in the oxidation of iron and mild steel in CO_2 is the diffusion of iron across the inner of two layers of magnetite scale. Cation diffusion is directed towards available oxidant and hence tends to produce fresh oxide in freely available space. The initial oxidation process is thus protective and stress-free. As oxidation proceeds, the gaseous reaction product, carbon monoxide, tends to accumulate at the oxide/metal interface. Eventually this leads to simulataneous carbon deposition and oxide formation. This carbon contamination allows oxidant access to oxide crystallite jacking points, and hence volume expansion and stressed breakaway corrosion can occur. Experiments designed to simulate the promotion, propagation, and healing of breakaway oxidation and to define the conditions for carbon deposition are reported. (auth)

26534 HIGH TEMPERATURE OXIDATION OF STRUCTURAL STEELS. Leach, J. S. L.; Nehru, A. Y.; Taylor, D. E.; Taylor, M. F. (Nottingham Univ., Eng.). pp 97-108 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Considerable research has recently been carried out on the oxidation behavior of mild steel in high temperature, high pressure carbon dioxide based atmospheres. However, the rate controlling steps in the process appear as yet not to be fully interpreted. In particular, the mechanism of porous structure formation and carbon deposition within the inner layer of the duplex scale deserve further study. Results from a program designed to investigate the mechanisms leading to breakaway oxidation are reported. The effects of controlled experimental variables upon the morphology of scales forming on mild steels and the scale-metal interface are being assessed. A wide range of physical techniques has been employed to characterize oxide scales and some recent observations are reported which may help in an understanding of the oxidation mechanisms. (auth)

26535 EFFECT OF COATINGS AND GASEOUS ADDITIVES ON THE OXIDATION OF MILD STEEL. Garrett, J. C. P. (Central Electricity Generating Board, Manchester, Eng.); Rowlands, P. C.; Hodgkiess, T. pp 109-120 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The discovery of corrosion of mild steel components in Magnox reactors has led to a comprehensive search for palliatives both in the form of coatings and of gas phase inhibitors. In the initial studies a scan of a wide range of possible inhibitors has been undertaken and this has been followed by a more detailed investigation of those found to be the most promising. The application of silica coatings, nitriding in ammonia, and gas phase injection of sulfur compounds increases the time to breakaway of unoxidized free surfaces coated with graphite paint, whereas gas phase injection of the oxides of nitrogen and nitriding decreases breakaway oxidation rates. However, the inability to act at interfaces and/or incompatibility with reactor operation eliminate them from practical application. In general, the main role of the inhibitors appears to be the inhibition of the decomposition of carbon monoxide on the metal surface. (auth)

26536 DEVELOPMENT OF TECHNIQUES FOR MONITORING CORROSION IN MAGNOX PLANT. Haines, N. F.; Whittle, I.; Wilson, R. (Central Electricity Generating Board, Berkeley, Eng.). pp 121-129 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Steel oxidation in Magnox reactors has led to the development of techniques for measuring oxide thicknesses. An account is given of the methods used by the CEGB for making non-destructive measurements of oxide coatings both in the laboratory and remotely in the core regions of reactors. Specific techniques include beta back-scattering which is compared with conventional microscope or weight gain methods for particular applications. The laser corrosion monitor and an ultrasonic method are described and compared as in-reactor techniques. An eddy current method is being developed for reactor regions where access is extremely restricted. The effects of oxide form upon the response of the instruments are discussed. The necessary further work is described which establishes the usefulness of each instrument over a range of oxide thicknesses and steels of different physical properties. (auth)

26537 OXIDATION OF STEELS IN MAGNOX AND AGR STATIONS. Inspection and Licensing Aspects. Goodison, D. (Dept. of Energy, London). pp 130-140 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

An outline is given of the involvement of the Nuclear Installations Inspectorate in the study of the oxidation of steels used in Magnox and AGR gas circuits. The early investigations during operation of some Magnox reactors of interface oxidation combined with breakaway oxidation kinetics caused reappraisals of safety aspects. New safety problems during normal operation and postulated fault conditions were considered. The Nuclear Installations Inspectorate were concerned in agreeing with the licensees the nature of these safety problems and their solution in some cases by modification to reactor operations, further theoretical and laboratory studies, and changes to the licensing procedure. The experience gained has naturally allowed better appraisal of the safety aspects of the oxidation of steels at AGR stations. Two major innovations are the introduction of oxidation schedules which give details of components and oxidation monitoring schemes. Possible future NII requirements concerning these aspects are briefly described and the usage of the results of monitoring schemes is discussed. The study of the oxidation processes of steels in CO_2 atmospheres is consequently part of the activities of the NII, some of whose views on the requirements for further laboratory studies are given. (auth)

26538 DISCOVERY AND ASSESSMENT OF ACCELERATED CORROSION IN Fe-9Cr ALLOYS AND STEELS. Holmes, D. R. (Central Electricity Research Labs., Leatherhead, Eng.); Mortimer, D.; Newell, J. pp 151-164 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

A brief review is given of the corrosion data leading to the acceptance of 9 Cr 1Mo steel for the evaporator and primary superheater sections of CAGR boilers. Later experiments led to the discovery of breakaway corrosion in this material and necessitated an immediate assessment of the implications. Subsequently sophisticated statistical methods for estimating probabilities of breakaway and of component failure were developed. A number of research programs have been initiated to provide more extensive data for these assessments and to find methods and operating conditions for delaying the onset of breakaway or for reducing breakaway rates. Progress in the development of the most promising surface treatment technique to delay breakaway, selective pre-oxidation, is described. In the meantime, engineering and materials solutions have been adopted to reduce corrosion to acceptable levels in CAGRS. (auth)

26539 STUDIES OF THE OXIDATION OF 9 AND 12Cr STEELS IN HIGH TEMPERATURE, HIGH PRESSURE CO_2. Brierley, R. A. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). pp 165-179 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The historical development of the B. N. D. C. oxidation test programs covering 9 and 12 Cr steels is reviewed from the inception of tests in 1962 to the expansion caused by the recognition of a possible "9 Cr problem" in 1971. The observed effects on oxidation behavior of relevant environmental and materials variables are outlined, with reference to CAGR operation. Finally the determination of post-breakaway oxidation rates at temperatures in the range 673 to 923°K is described. (auth)

26540 9Cr-Mo STEELS BREAKAWAY EFFECTS IN CO_2 COOLANT MEDIA. Taylor, J. W.; Trotsenberg, P. V. (Babcock and Wilcox Ltd., Renfrew, Eng.). pp 180-192 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Relevant data from three specific B. & W. (Ops) Ltd. 9Cr-Mo CO_2 oxidation programs are used to highlight aspects which appear to predetermine the existence of a breakaway phenomenon in the 9% Cr composition range. These are specifically (i) the influence of Cr content change in a series of ferritic steels with from 4.84% to 20.8% Cr, and (ii) for the 9% Cr composition, temperature dependence characteristics in the 550 to 600°C range which range from rate inversion in the higher Si materials to rapid breakaway in the lower Si alloys. In terms of long term exposure effects under realistic operational conditions data on Si content and on thermal step transient effects in 9 Cr-Mo steels are highlighted in terms of operational significance. (auth)

26541 OXIDATION OF 9% Cr STEELS IN HIGH PRESSURE HIGH TEMPERATURE CO_2. Rowlands, P. C.; Garrett, J. C. P.; Hicks, F. G. (Central Electricity Research Labs., Leatherhead, Eng.). pp 193-207 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Two of the C. E. G. B.'s major programs on the oxidation of 9%Cr steels are described. A large scale laboratory monitoring experiment has been started in which a wide range of production steels in the as-installed conditions are being oxidized in two possible AGR coolant compositions. This experiment is providing a substantial lead time for station operating experience and concurrent monitoring programs. The results obtained to date show a pronounced effect of silicon content on steel oxidation behavior, but little difference between the results in the two gas compositions considered. The second program of work is mainly designed to examine the influence of gas composition on oxidation kinetics and to predict behavior at low temperatures. The results obtained to date indicate that increasing the H_2O content or the CO content of the gas decreases times to breakaway. The protective oxidation rates decrease with increasing silicon content of the steel and with decreasing water content of the gas. (auth)

26542 ASSESSMENT OF THE OXIDATION BEHAVIOR OF 9% Cr STEELS IN CO_2. Grandison, N. O.; Facer, R. I. (Nuclear Power Group Ltd., Risley, Eng.). pp 208-219 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Data from 1500 specimens of 9% Cr oxidized in CO_2 based atmospheres have been examined, statistically treated and used for quantitative predictions. The effects of gas pressure, steel composition, surface finish, and temperature on protective oxidation behavior have been noted and in the cases of silicon content and temperature quantified. The probability of breakaway initiation versus weight gain has been quantified, together with dependence of post-breakaway rate on temperature, and the results combined to produce metal loss predictions for steels of given silicon content at a known temperature. (auth)

26543 OXIDATION OF 9Cr-1Mo STEELS IN CARBON DIOXIDE. Discussion of Possible Mechanisms. Harrison, P. L. (Central Electricity Research Labs., Leatherhead, Eng.); Dooley, R. B.; Lister, S. K.; Meadowcraft, D. B.; Nolan, P. J.; Pendlebury, R. E.; Surman, P. L.; Wootton, M. R. pp 220-233 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The various types of oxide that occur during the oxidation of 9 Cr 1Mo steels in carbon dioxide in the temperature range 740 to 920°K are described in terms of oxide morphology, kinetics, and composition. A number of mechanisms, consistent with the available data, are presented for each type. The basic protective oxide scale unit consists of two layers, the outer of magnetite and the inner of chromium-containing spinel. This scale grows at both surfaces of the unit with iron diffusion through the chromium-containing layer as the rate-controlling process. The modifications of this basic unit to produce either thin or multi-layered protective oxide are described and possible mechanisms whereby they occur are presented. The production of non-protective oxide is described and criteria for its initiation and its healing are put forward. (auth)

26544 MECHANISTIC EXPERIMENTS ON THE OXIDATION OF 9% STEELS IN CO_2 AT 550°C. Pritchard, A. M.; Truswell, A. E. (United Kingdom Atomic Energy Authority Research Group, Harwell, Eng.). pp 234-246 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Specimens of 9% Cr steels with different S and Si contents have been oxidized at 550°C in 4 MN m^{-2} CO_2 with 1000 and 8 vol ppM H_2O, and in 0.1 MN m^{-2} CO_2 with 1000 vol ppM H_2O. The lowest rates of oxidation have been found for steels with the highest S and Si contents, and in the as-received condition rather than normalized and tempered. Non-protective behavior has only been observed consistently for a 0.04% Si, 0.007% S steel, and only in 4 MN m^{-2} CO_2 with 1000 vol ppM H_2O. Departure from protective behavior is accompanied by a change from a two-layered scale to four or more layers. Protective oxidation results in the growth of a layer of Fe_3O_4 outside the original limits of the specimen, with an inner Cr- and Si-rich layer which sometimes shows evidence of ghost grains. Non-protective behavior appears to be associated with the nucleation of Fe_3O_4-rich layers within the original inner layer, causing transport of Fe to the outer scale/gas interface to cease. The carbon content of the scale has been found to increase with increasing thickness, to be lower at 0.1 MN m^{-2} CO_2 than at 4 MN m^{-2} for the same weight gain, and to be independent of moisture content. ^{14}C tracer studies show maximum deposition within the inner scale near the scale/metal interface. (auth)

26545 STRUCTURE AND GROWTH OF OXIDE ON IRON-CHROMIUM ALLOYS. Cox, M. G. C.; McEnaney, B.; Scott, V. D. (Bath Univ., Eng.). pp 247-256 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Several oxides form during the initial stages of oxidation of iron-chromium alloys at 400 to 600°C in CO_2-1% CO gas. The nature of the oxidation product depends upon crystallographic orientation and composition of the substrate and can be explained by considering the maximum solubility of chromium in different oxide phases together with interfacial and strain energy factors. Kinetics of oxidation together with micrographic observations indicate that, as oxidation proceeds, spinel oxide M_3O_4 nucleates at sites on the substrate surface associated with asperities. The spinel nuclei grow laterally and vertically until they coalesce and the scale subsequently thickens according to a parabolic rate law. The duplex structure of scales is interpreted in terms of an outward diffusion of cations together with simultaneous growth of an inner layer in the space created by this outward movement. Scale porosity provides a route for gas-phase transport of oxidant to support the growth of the inner layer. Regularly spaced lamellar voids which may form in the inner layer are believed to be associated with a cyclic vacancy condensation process. Enrichment of the inner layer in chromium is explained by analysis of the possible diffusion path networks in close-packed oxides. Some comments are made concerning possible practical applications of these data. (auth)

26546 METHODS OF CONTROLLING THE OXIDATION OF 9Cr-1Mo STEEL IN HIGH TEMPERATURE CO_2. Surman, P. L.; Bettelheim, J.; Dooley, R. B.; Graham, J.; Meadowcroft, B.; Rowlands, P. C. (Central Electricity Research Labs., Leatherhead, Eng.). pp 257-271 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

An investigation of palliative measures, which could increase the corrosion resistance of 9Cr/1Mo steel in the Advanced Gas Cooled Reactor, has been carried out. Methods designed to increase the surface concentration of silicon, boron, and chromium were investigated. Silicon and chromium rich surface layers were very effective in reducing corrosion rates; however the design and construction of the AGR boilers make the silicon-based coatings difficult to apply in practice. A method of selective pre-oxidation of the steels to form a chromium rich tarnish layer is the most promising treatment which could be applied to assembled boiler units. (auth)

26547 SURVEY OF THE OXIDATION BEHAVIOUR OF STAINLESS STEELS IN CO_2 ENVIRONMENTS. Allan, S. J.; Norton, J. F.; Popple, L. A. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). pp 284-297 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The oxidation behavior of stainless steels in A. G. R. conditions is reviewed. Sorting tests on a range of materials led to the choice of 20/25/Nb as the cladding material for the A. G. R. fuel element. The endurance of this material for the design life

of the fuel element has since been confirmed. In examining the oxidation resistance of other stainless steels including 12% Cr, 15% Cr, 18/8 and 25/20 steels, operating at ~923°K, power law and logarithmic weight gain time relationships have been observed. Within the 18/8 family of steels, although the oxidation rates invariably reduce with time, the weight gain acquired in the first 10,000 hours of test can vary by an order of magnitude. This has been shown to be due to the preferential formation, at a faster rate, of a duplex oxide, the outer layer of which is iron-rich, rather than the thinner, classical chromium rich oxide. Factors influencing this, including surface finish, thermal cycling, and composition, are discussed. (auth)

26548 FACTORS IN THE OXIDATION OF AUSTENITIC STAINLESS STEELS. Garrett, J. C. P.; Lister, S. K.; Nolan, P. J.; Crook, J. T. (Central Electricity Generating Board, Manchester, Eng.). pp 298-310 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Specimens of C. A. G. R. austenitic stainless steels based on the compositions 25% Cr/20 Ni and 18% Cr/8% Ni have been oxidized in a simulated carbon dioxide coolant at 4.14 MN m^{-2} and 923°K for 5000h. The steels have been exposed with the realistic reactor surface finishes in order that the in-service behavior can be predicted. Kinetic data have been obtained by intermittent weighing, and the nature of the oxidation attack revealed by metallographic examination. The 25% Cr/20% Ni steels were clearly more oxidation resistant than the 18% Cr/8% Ni materials. However, tentative extrapolation of the kinetic data indicated that all steels were oxidizing within the design limits. The oxidation resistance of the highly alloyed steels was due to the formation of a protective chromia (Cr_2O_3) film, while a less protective duplex oxide was the predominant mode of oxidation for the 18% Cr/8% Ni steels. The particular oxide produced is dependent upon the availability of chromium at the metal surface, and the growth of the duplex oxide is strongly dependent upon the silicon content of the steel. Precipitation reactions involving slight carburization of the steels which formed duplex oxide, and the general formation of sigma phase in both steels have been observed. (auth)

26549 ROLE OF PHASE STABILITY AND METAL LATTICE DIFFUSION IN THE HIGH TEMPERATURE OXIDATION OF STAINLESS STEELS. Hales, R.; Smith, A. F.; Killeen, J. C. (Central Electricity Generating Board, Berkeley, Eng.). pp 311-319 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The available oxidation data for a wide range of iron-chromium alloys have been reviewed in an attempt to obtain a better understanding of the oxidation behavior. There are two main types of oxidation behavior; the exclusive formation of Cr_2O_3 or the more rapid growth of duplex oxide. The former desirable behavior can sometimes degenerate and give way to the latter type of behavior. In the case of austenitic steels, it is shown that the formation of Cr_2O_3 is probably controlled by metal lattice diffusion not oxide diffusion as has generally been assumed. This mechanism results in extensive depletion of chromium close to the metal surface. If this chromium depleted region is exposed, nucleation of the more rapidly growing spinel scale is favored. Factors in the production and the composition of stainless steel likely to result in the exposure of chromium depleted surfaces are discussed. (auth)

26550 OXIDE FAILURE AND ACCELERATED OXIDATION. Hancock, P.; Hurst, R. C. (Cranfield Inst. of Tech., Bedford, Eng.). pp 320-329 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The processes by which steels suffer accelerated oxidation in carbon dioxide containing environments are briefly discussed and the concept of considering the mechanical stabilities of the surface oxides on the steels is introduced. Their influence on the breakaway phenomenon is suggested and the effects of steel composition, operating stresses, component geometry and thermal cycling are briefly examined. (auth)

26551 MECHANISTIC ASPECTS OF THE REACTIONS OF AUSTENITIC STAINLESS STEEL WITH CARBON DIOXIDE AT HIGH TEMPERATURES. Antill, J. E.; Truswell, A. E. (United Kingdom Atomic Energy Authority Research Group, Harwell, Eng.). pp 330-337 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The reactions of austenitic stainless steels with carbon dioxide are considered in a mechanistic sense. Specifically, previous work on the behavior of a 20% Cr–25% Ni–Nb steel at 650 to 850°C is reviewed and unpublished data are reported for an 18% Cr–9% Ni–Ti steel at 660°C. For the higher alloyed steel the only significant reaction is oxidation and the resistance of the steel derives primarily from a thin protective oxide layer at the oxide/metal interface. Spalling of the oxide results from thermal cycling but in general it is only the outer non-protective oxide which spalls. The behavior of the lower alloyed steel is governed to a far greater extent by the thermal cycling history. Little attack results from isothermal exposure and from frequent thermal cycling. A pronounced step increase in attack is obtained when the first thermal cycle occurs after >250h exposure. The magnitude of the step increases with the total pressure and the water vapor content of the gas. Significant amounts of carbon are transferred from the gas to the metal during the step. (auth)

26552 EFFECT OF HEAT TREATMENT ON THE SHORT TERM OXIDATION OF 18/8 STAINLESS STEEL IN CO_2. Whitlow, W. H.; Wild, R. K. (Central Electricity Generating Board, Berkeley, Eng.). pp 338-348 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Samples of 18/8 stainless steel (type EN58A) have been vacuum annealed for 5 h at 1073°K in either a dynamic or a static vacuum. These, together with as received samples, were oxidized at 973°K for 168h in one atmosphere of flowing CO_2 and examined by scanning electron microscopy, energy dispersive x-ray analysis, x-ray diffraction, and Auger electron spectroscopy. The elements manganese and carbon were removed from the bulk during annealing and the consequences of this on the stability of the austenite and hence on the subsequent oxidation characteristics are discussed. It is concluded that vaporization of manganese and carbon during dynamic annealing could in certain cases result in the formation of ferrite in the steel. (auth)

26553 CHROMIUM DEPLETION DURING OXIDATION OF STAINLESS STEEL FOILS. Cowen, H. C. (United Kingdom Atomic Energy Authority Reactor Group, Risley, Eng.); Webster, S. J. pp 349-358 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

The depletion of chromium in a foil due to selective oxidation is considered. At the alloy/oxide interface this occurs as a two-stage process. Chromium is lost relatively early to a level fixed by the ratio of parabolic rate constant to diffusion coefficient (K/D). Thereafter, it remains fairly constant until the chromium-depleted zone reaches the midplane of the foil. A further fall then occurs at the alloy/oxide interface, and continues as a function of Dt/l^2 (t time, l half-thickness), ultimately reaching zero. Experimental results for the oxidation of very thin foils (4.8 to 9.5 microns) of 25% Cr/20% Ni stainless steel are considered in the light of this theory. The implications are considered for foils (100 microns thick) used for insulation in Advanced Gas-Cooled Reactors. Finally, the situation is analyzed where sigma-formation occurs during oxidation. (auth)

26554 EFFECT OF SURFACE TREATMENT WITH RARE EARTH OXIDE ON THE OXIDATION OF 20/25/Nb STAINLESS STEEL. Tyzack, C. (United Kingdom Atomic Energy Authority Reactor Group, Risley, Eng.); Cowen, H. C.; Farrow, M.; Longton, P. B.; Whitlow, W. H. pp 359-368 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Experiments are described in which 20/25/Nb stainless steel samples with surfaces bearing small quantities of rare earth oxide (typically 0.05 mg/cm^2) are oxidized in CO_2-based gas at temperatures in the range 750 to 900°C. The rare earth affects a significant improvement in oxidation resistance during the early stages of such tests, although the improvement is not maintained. Evidence is presented for a reduction of the outward movement of cations when scale grows on surfaces on which rare earth oxide is present. The scale itself is nucleated beneath the RE oxide, the bulk of which (possibly not all) is at the outside of the system. The results are discussed in terms of the ability of the RE oxide to function as an n-type semi-conductor initially restricting passage of cations, but gradually becoming ineffective due to passage of oxygen through the film and nucleation of Cr_2O_3 beneath the ceria layer. It is suggested that if the two layers could be transposed an even better result might be achieved by the formation of a p-n junction with forward bias inhibiting ionic passage in both directions. This has not so far been achieved in practice. (auth)

26555 ASPECTS OF THE OXIDATION BEHAVIOUR OF NITRIDED 20 WT % Cr–25 WT % Ni STAINLESS STEELS CONTAINING TITANIUM. Evans, H. E.; Hales, R.; Hilton, D. A.; Holm, R. A.; Knowles, G.; Pearce, R. J. (Central Electricity Generating Board, Berkeley, Eng.). pp 369-380 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Oxidation results at 850°C on an experimental 20 wt % Cr–25 wt % Ni stainless steel strengthened by a dispersion of TiN particles. The material is prepared by an internal nitridation process and the effect of residual nitrogen content on the oxidation behavior is found to be significant. Large quantities lead to poor oxidation properties and this effect is correlated with bulk chromium depletion and silicon substitution for chromium in the protective M_2O_3 oxide. The local attack kinetics are described by a multi-stage process which reflects the nature of the bulk oxide film. The results obtained are compared with the behavior of standard 20 wt % Cr–25 wt % Ni/Nb stabilized stainless steel. (auth)

26556 DESIGN ENGINEERING IMPLICATIONS AND ASSESSMENT. Brown, J. (Central Electricity Generating Board, Barnwood, Eng.). pp 381-389 of International Conference on Corrosion of Steels in CO_2. Holmes, D. R. (ed.). London; British Nuclear Energy Society (1974).

From British Nuclear Energy Society international conference on corrosion of steels in CO_2; London, United Kingdom of Great Britain and Northern Ireland (UK) (23 Sep 1974). See CONF-7409139-.

Designers have had to learn to take account of steels corrosion which may turn out to be much greater than data extrapolated from short-term tests. Wherever breakaway oxidation can occur, steps must be taken to avoid interface corrosion and bolt failure, particularly in mild steel. 9%Cr boiler material is now known to suffer from breakaway corrosion and although the economic life of the station appears unlikely to be reduced because of boiler failure, some output loss over life occurs. Oxide on the cladding material of the fuel pins is expected to spall off especially as a result of large temperature changes. In order to reduce radiation hazards from these active particles which may settle in low-velocity areas of the circuit, central inertial collectors are being fitted to the outlets of about half the fuel channels, but boiler oxidation products will necessitate a much increased collector capacity. Active oxide particles from the fuel pins may contaminate the irradiated fuel handling route, including the cooling ponds, which would cause maintenance difficulties. (auth)

26557 STUDY OF PASSIVE FILMS FORMED ON STAINLESS STEEL SURFACES, USING AUGER SPECTROSCOPY. Rondot, B.; Pons, F.; Le Hericy, J.; Da Cunha Belo, M.; Langeron, J. P. (Centre National de la Recherche Scientifique, 94–Vitry-sur-Seine (France). Centre d'Etudes de Chimie Metallurgique). Vide; 30: No. 176, 70-75(Mar 1975). (In French)

Characterization of passive films formed on stainless steel (26% Cr and 0 to 3% Mo) is discussed. The influence of the applied passivation potential and the effect of molybdenum additions to steel upon the composition profiles of passive films formed in an aqueous NaCl solution (3.5% at pH 2.5) are studied. The technique involved is Auger electron spectroscopy combined with ion sputtering. Some electrochemical techniques have been used in conjunction. A quantitative approach of the Auger spectra during the progressive removal of the passive film is described. The peak-to-peak height of the Auger lines are treated in order to yield the atomic fraction of the various elements present in a given subsurface layer. The analytical study of the film by electron spectroscopy indicates that molybdenum plays a part at the metal-oxide interface where this element acts on the chromium diffusion process. This phenomenon, which depends on the imposed potential, may lead to the formation of sublayers having a very low current efficiency in cathodic reduction measurements. The informations obtained by Auger spectroscopy are confirmed by ion mass spectrometry. (FR)

26558 LAWS GOVERNING CHANGES TAKING PLACE IN THE CHEMICAL COMPOSITION OF THE SURFACE LAYERS OF TURBINE BLADES DURING ACTIVE SERVICE. Tret'yachenko, G. N.; Kosygin, E. P.; Kravchuk, L. V. (Inst. of Strength Problems, Kiev). Strength Mater. (USSR) (Engl. Transl.); 7: No. 3, 272-277 (Mar 1975).

Translated from Probl. Prochnosti; 7: No. 3, 12-16(Mar 1975).

Spectral analysis was used to determine changes taking place under thermal cycling in the surface layers of turbine blades of EHP 99 and EHI 826. Results indicate that the surface is impoverished in Ti, Cr, Al, and Mn, and enriched in Mo, Fe, and W. (DLC)

26559 INITIAL OXIDATION AND SELF-DIFFUSION PHENOMENA ON METAL SURFACES. Srinivasan, S. R. Ames, IA; Iowa State Univ. (1975). 129p. University Microfilms Order No. 76-1874.

Thesis (Ph. D.).

The adsorption characteristics of oxygen on a vanadium (100) surface have been investigated using low energy electron diffraction techniques. The presence of ordered atomic arrangement corresponding to (1x1) and (2x2) patterns on the surface has already been reported in literature. The present study shows the existence of another ordered structure, which is between these two structures. The analysis and indexing of the diffraction pattern which corresponds to this intermediate structure have been carried out to determine the relative position of the oxygen and vanadium atoms on the surface, and this ordered arrangement of atoms on the surface has been confirmed by laser simulation of the observed diffraction pattern. An understanding of surface oxidation requires a knowledge of surface diffusion coefficient. Various theories of grain boundary groove growth for the determination of D/sub s/ are critically reviewed. A theory of grain boundary groove is extended to incorporate the matter transport occurring by the concomitant action of surface diffusion, volume diffusion, and evaporation-condensation mechanisms. The groove profiles have been predicted in terms of a dimensionless parameter, p, which measures the relative importance of the surface and volume diffusion mechanisms. It is shown that the matching of the present theory with the experimental data on grain boundary grooving enables simultaneous determination of both the surface and volume diffusion coefficients. The theoretical results are compared with the experimental data on a copper (100) surface. (Diss. Abstr. Int., B.)

26560 CORRELATION OF THE SURFACE LAYER STRESS COEFFICIENT AND STRESS CORROSION CRACKING. II. Kramer, I. R. (Navy Ship Research and Development Center, Annapolis). Corrosion; 31: No. 11, 391-394(Nov 1975).

Analytical expressions are presented that relate the crack velocity and the failure time to the surface-layer stress coefficient for compact-tension specimens of Ti-6Al-4V and a 4130 steel subjected to stress corrosion cracking (SCC). The experimental data for the threshold stress intensity factor and the crack velocities for various stress intensity factors agree well with the calculated values. (auth)

26561 CORRELATION OF THE SURFACE LAYER STRESS COEFFICIENT AND STRESS CORROSION CRACKING. I. Kramer, I. R. (Navy Ship Research and Development Center, Annapolis). Corrosion; 31: No. 11, 383-390(Nov 1975).

The time to failure, the crack propagation velocity, and the surface layer stress of titanium (6 Al-4 V) and a 4130 steel were measured as a function of applied potential and concentration in solutions of HCl-CH_3OH and NaCl. Compact tension specimens were used in the SCC tests. It is shown that a direct correlation, independent of the applied potential or solution concentration, exists between the surface layer stress and SCC. The data show that the resistance to stress corrosion cracking (SCC) decreases under conditions that enhance the strength of the surface layer. It appears that SCC occurs when the environmental conditions raise the surface layer stress coefficient above a critical value. (auth)

26562 CREEP RUPTURE PROPERTIES OF SOME HIGH TEMPERATURE REACTOR CIRCUIT MATERIALS IN HELIUM. Wood, D. S.; Farrow, M.; Baldwin, A. B.; Burke, W. T. (UKAEA, Springfields, Eng.). pp 158.1-158.9 of Creep and Fatigue in

Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Creep rupture tests in air and in helium containing nominally 500:500:50:50 ppM of H_2:CO:H_2O:CH_4 have been carried out on three ferritic and three austenitic steels for durations of up to 10,000 h at temperatures ranging from 400 to 800°C. The helium environment was found to reduce the creep and rupture strengths of the austenitic steels at 650 to 750°C by 5 to 15 percent whereas a smaller environmental effect was observed on a 1 percent Cr steel at 500°C and a $2^1/_4$ percent Cr steel at 550°C. No effect of environment was detected on mild steel at 400°C. The creep and rupture behavior is shown to be consistent with the metallographic findings which indicated that specimens tested in helium often contained deeper surface cracks and in all cases showed differences in the oxidation behavior. (auth)

26563 Na_2SO_4- AND NaCl-INDUCED HOT CORROSION OF SIX NICKEL-BASE SUPERALLOYS. Bourhis, Y.; St. John, C. (Ecole Nationale Superieure des Mines de Paris, Corbeil-Essonnes, France). Oxid. Met.; 9: No. 6, 507-528(Dec 1975).

The short-time hot-corrosion behavior of six industrial nickel-base superalloys was investigated with static deposits of Na_2SO_4 or NaCl or both in still air. The oxidation kinetics and scale morphologies were measured with traditional laboratory techniques—thermobalance, metallography, electron microprobe, and x-ray analyses. Susceptibility to hot corrosion was found to be correlated to the type of scale produced during simple oxidation. Alloys forming an Al_2O_3 scale were found to be susceptible to Na_2SO_4 deposits, independent of their chromium content. The quantity of Na_2SO_4 deposit dictated the nature of the attack and, under certain conditions, the refractory element alloy additions appeared to play an essential role. Alloys containing Cr_2O_3 or TiO_2 in the simple oxidation scale proved to be sensitive to NaCl attack. Again, the severity of the attack within the susceptible alloy group was not related to the chromium or titanium content. Although less intensive than the Na_2SO_4-induced hot corrosion, NaCl contaminations provoked extensive spalling. All of the hot-corrosion types encountered in this study were interpreted in the light of existing theories. (auth)

Preparation and Fabrication

Refer also to abstracts 25834.

26564 (AED-CONF-74-538-038) EFFICIENCY INCREASE IN SUBMERGED-ARC WELDING WITH STRIP ELECTRODE. Huwer, W.; Eichhorn, F. 1974. 7p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

13 figs.; 1 tab.; 6 refs. Available from ZAED. Special print of DVS-Bericht, v. 32, Deutscher Verl. f. Schweisstechnik, Duesseldorf.

The efficiency is increased by higher welding speed through the use of wide strip electrodes. Use of magnetic arc control, arc behavior, and material transfer in cladding with wide strip electrodes are considered. (DE)

26565 (AED-CONF-74-538-043) APPLICATION OF EB-WELDING FOR MANUFACTURE OF STEAM BOILER ELEMENTS IN A LOW ALLOY, MANGANESE CONTAINING STEEL (WALL THICKNESS 123 mm). Masnou, C.; Foulquier, H.; Saglio, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). 1974. 8p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

17 figs. Available from ZAED.

The EB-welding under local vacuum of big steam boiler elements, manufactured in a low alloy steel, was entirely successful. Nondestructive testings did not show any failure in the welded seams. (DE)

26566 (AED-CONF-75-538-046) PLASMA HOT WIRE CLADDING IN NUCLEAR MANUFACTURE. Bernstein, A.; Areskoug, M.; Kirmborn, G.; Ruckdeschel, W.; Knoch, R. (Sandvik AB (Sweden)). 1974. 6p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

8 figs.; 3 tabs.; 4 refs. Available from ZAED.

Evaluation of the plasma hot-wire cladding method is presented. Practical experience, productivity, control of process parameters are considered. The weld metal surface and ultrasonic testing of weld deposits are discussed. Studies were also of weld deposits and the base metal. (DE)

26567 (AED-CONF-74-538-048) NEW UNDERSTANDING OF THE MIG-WELDING OF AUSTENITIC STEELS. Thier, H.; Plaschka, K. 1974. 203-213p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

18 figs.; 3 tabs.; 28 refs. Available from ZAED.

Welding feature of the electrode, feedability, arc-stability, metal-transfer, porosity, alloy element loss, dilution, chemical composition and ferrite content of the weld deposit, intergranular corrosion, time – temperature – sensitivity diagrams, stabilization by niobium, and postweld heat-treatment are discussed. (DE)

26568 (AED-CONF-74-538-049) QUALITY FEATURES OF AUSTENITIC-COVERED WELDING ELECTRODES FROM THE METALLURGICAL POINT OF VIEW. Linssen, G. 1974. 11p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

11 figs.; 3 tabs.; 22 refs. Available from ZAED.

Selection of covered welding electrodes for weld overlays and joints, welding problems, and welding technology are discussed. Alloy element loss and gain, weld deposit composition and ferrite content, hot cracking, intergranular corrosion, and ductility are also considered. (DE)

26569 (AED-CONF-74-538-052) HARD-FACING OF HEAT-RESISTANT ALLOYS ON SEALING SURFACES OF HIGH PARAMETER STEAM VALVES. Frumin, I.; Gladkij, P.; Jeremeew, W.; Pereplotschikow, E. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrosvarki). 1974. 9p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

13 figs.; 1 tab.; 18 refs. Available from ZAED.

Co–Cr–W alloys can be substituted by Ni–Cr–B–Si alloys. Effect of components on alloy properties, plasma-powder hard-facing, manufacture, and operation of the hard-faced parts is discussed. (DE)

26570 (BNWL-SA-5447) PREPARATION AND CHARACTERIZATION OF THICK METASTABLE SPUTTER DEPOSITS. Allen, R. P.; Dahlgren, S. D.; Merz, M. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 9p. (CONF-751172-2). Dep. NTIS $3.50.

From second international conference on rapidly quenched metals; Cambridge, Massachusetts, United States of America (USA) (17 Nov 1975).

High-rate dc supported-discharge sputtering techniques were developed and used to prepare 0.1 mm to 5.0 mm-thick deposits of a variety of metastable materials including amorphous alloys representing more than 15 different rare-earth-transition metal systems and a wide range of compositions and deposition conditions. The ability to prepare thick, homogeneous deposits has made it possible for the first time to investigate the structure, properties, and annealing behavior of these unique sputtered alloys using neutron diffraction, ultrasonic, and other experimental techniques that are difficult or impractical for thin films. More importantly, these characterization studies show that the structure and properties of the massive sputter deposits are independent of thickness and can be reproduced from deposit to deposit. Other advantages and applications of this metastable materials preparation technique include the possibility of varying structure and properties by control of the deposition parameters and the ability to deposit even reactive alloys with a very low impurity content. (auth)

26571 (CEA-CONF-3072) USE OF A HIGH TEMPERATURE HYDROSTATIC EXTRUSION TECHNIQUE FOR POWDERS STRENGTHENING. Decours, J.; Gavinet, J.; Weisz, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Technologie). 1975. 6p. (In French). INIS.

From 4th European symposium for powder metallurgy; Grenoble, France (13 May 1975).

A conventional 575 tonnes extrusion press has been modified by a device permitting the extrusion process by hydrostatic pressure through a leakless mechanical set (13,000 bars maximum), from room temperature to 1,200°C. This new device allows: the high temperature hydrostatic extrusion for strengthening of powders, the isostatic compression of powders. Examples of realisations obtained by this process are described, including the influence of different parameters: pressure, temperature, extrusion ratio and for different materials: pure metals (iron, nickel, niobium, etc...) and alloys (stainless steel, molybdenum, niobium nickel alloys, etc...). Then, the advantages of the process are emphasized. (FR)

26572 (CEA-CONF-3160) COMPARATIVE STUDY OF TANTALUM DEPOSITION BY CHEMICAL VAPOR DEPOSITION AND ELECTRON BEAM VACUUM EVAPORATION. Spitz, J.; Cheval-

lier, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 28 Apr 1975. 11p. INIS.

From 5th international conference on chemical vapour deposition (CVD-5); Stoke Poges, UK (22 Sep 1975).

The coating by tantalum of steel parts has been carried out by the two following methods: chemical vapor deposition by hydrogen reduction of $TaCl_5$ (temperature = 1100°C, pressure = 200 mmHg, $H_2/TaCl_5 = 10$); electron beam vacuum evaporation. In this case Ta was first condensed by ion plating ($P(Ar) = 5 \times 10^{-3}$ up to 2×10^{-2} mmHg; U(c) = 3 to −4kV and J(c) = 0.2 to 1 $mAcm^{-2}$) in order to ensure a good adhesion between deposit and substrate; then by vacuum condensation (substrate temperature: 300 to 650°C) to ensure that the coating is impervious to HCl and H_2SO_4 acids. The advantages and inconveniences of each method are discussed. (FR)

26573 (CEA-CONF-3162) A NEW HOT PRESSING TECHNIQUE. Carcey, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 1975. 7p. (In French). INIS.

From 4th European symposium for powder metallurgy; Grenoble, France (13 May 1975).

An original hot pressing method that may be applied to ceramics, metals, and refractory powders is described. The products obtained are fine grained polycrystalline materials, with homogeneous structure, very high density, unstrained and of very large dimensions (several square meters). This process equally applies to composite materials including powders, fibers, etc. (FR)

26574 (PB-239525) APPLICATION OF WELD FORMING TECHNIQUE TO MANUFACTURING OF AUSTENITIC STAINLESS STEEL ELBOW FOR NUCLEAR POWER PLANT SERVICE. Mitsubishi Technical Bulletin. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). Dec 1974. 20p. (MTB-96). NTIS $3.25.

Text in Chinese; summary in English.

In order to apply austenitic stainless steel pipes manufactured by the weld forming technique to the main coolant pipes of the light water reactor of the nuclear power plant, metallurgical, mechanical, and various other data required for the approval of new materials provided by the ASME Code Section III Appendix IV and also by the Japan Welding Engineering Society (J.W.S.) were established by using the elbow models of actual size manufactured by the weld forming technique. The various data acknowledged by the J.W.S. to be well applicable to the main coolant pipes of the light water reactor and also various data for the manufacture of weld formed elbows are presented. (GRA)

26575 (UCID-16997) METHODS FOR SURFACE TREATING METALS, CERAMICS, AND PLASTICS BEFORE ADHESIVE BONDING. Althouse, L. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Feb 1976. Contract W-7405-Eng-48. 21p. Dep. NTIS $4.00.

Methods for pretreating the surfaces of metals, ceramics, and plastics before they are coated with adhesive and used in assembly are described. The treatments recommended have been used successfully in the laboratory at LLL. Many are used in the assembly of nuclear devices. However, an unusual alloy or complex configuration may require trials before a specific surface treatment is chosen. (auth)

26576 NATURE AND DISTRIBUTION OF DEFECTS IN TUNGSTEN LAMP WIRE. Godfrey, T. J.; Lewis, R. J.; Smith, D. A.; Smith, G. D. W. (Oxford Univ.). J. Less-Common Met.; 44: 319-326(Jan 1976).

Results of an investigation on the early stages of bubble development in as-drawn W wire are presented. A grain boundary diffusion-controlled coarsening process involving K is suggested. If this process is correct, traces of dissolved K should be detected in grain boundaries adjacent to bubbles in lightly recrystallized material, the concentration of K depending inversely on the radius of the nearest bubble. Atom probe studies are being conducted to explore this possibility. (JRD)

26577 STUDY OF THE PROPERTIES OF TUNGSTEN COATINGS PRODUCED BY VAPOR-PHASE DEPOSITION. Kasatkin, Yu. S.; Nagibin, L. N.; Uzdalev, A. I.; Fokin, Yu. F.; Shurygin, V. A. (Saratov Polytechnic Inst., USSR). Strength Mater. (USSR) (Engl. Transl.); 7: No. 2, 247-250(Feb 1975).

Translated from Probl. Prochnosti; 7: No. 2, 111-114(Feb 1975).

A study has been made of the effect of sound vibrations during the production of protective tungsten coatings from the vapor phase on the properties of the coatings. The limits of the strength of adhesion of the coating to the base and the magnitude of the residual stresses have been determined. It was found that the introduction of sound vibrations into the reaction chamber during the deposition of tungsten improves the structure of the coatings obtained and increases the strength of the bond between the coatings and the base. (auth)

26578 TECHNICAL SURVEY OF SEAM TRACKING METHODS IN WELDING. Brown, K. W. Abington, Eng.; Welding Institute (1975). 129p.

This survey is of the state of art and potential applications of seam tracking methods in welding. Workpiece support, rail guidance, geometrical analogues, numerical control, transducers and memory systems, and commercial equipment are discussed. (DLC)

26579 WELD TESTING, INSPECTION, AND ACCEPTANCE SYSTEM FOR NUCLEAR POWER PLANTS. Kittner, M.; Kerstan, L. Schweisstechnik (Berlin); 25: No. 2, 66-69(Feb 1975). (In German)

A description is given of weld-testing, control, and acceptance criteria for establishing quality-control characteristics for nuclear power plants. (Metals Abstr.)

26580 ACTIVATION ANALYSIS FOR THE DETERMINATION OF OXYGEN IN THE DEVELOPMENT OF REFINING METHODS FOR ALUMINUM WROUGHT-ALLOY MELTS. Csak, J.; Szabo, L.; Vorsatz, B.; Zemplen-Papp, E. Neue Huette; 18: No. 10, 623-627(Oct 1973). (In German)

The determination of O in Al is discussed with reference to a neutron-activation-analysis method based on the $^{16}O(n,p)^{16}N$ reaction with measurement of the ^{16}N γ-radiation. The application of the method to the study of refining practice is described. (Metals Abstr.)

26581 MOLD WITH IMPROVED CORE FOR METAL CASTING OPERATION. Gritzner, V. B.; Hackett, D. W. (to U.S. Energy Research and Development Administration). US Patent Application 571,445. Filed date 25 Apr 1975. 5p.

The invention is directed to a mold containing an improved core for use in casting hollow, metallic articles. The core is formed of, or covered with, a layer of cellular material which possesses sufficient strength to maintain its structural integrity during casting, but will crush to alleviate the internal stresses that build up if the normal contraction during solidification and cooling is restricted. (auth)

26582 FABRICATION OF Nb_3(Al,Ge) SUPERCONDUCTORS BY PLASMA ARC SPRAYING. Dickinson, J. M.; Giorgi, A. L.; Riley, R. E.; Taub, J. M. (to U.S. Energy Research and Development Administration). US Patent Application 561,561. Filed date 24 Mar 1975. 19p.

A method is described of forming on a tubular metallic substrate, a superconducting coating having a high transition temperature. Powdered, substantially oxygen-free Nb/sub x/(Al, Ge) alloys, where x ranges from 2.5 to 3.3, is plasma arc sprayed on the substrate and annealed in an inert atmosphere. Niobium, titanium, and copper are particularly useful as substrates. (auth)

26583 ELECTRON BEAM WELDING. Schwartz, M. M. (Rohr Industries, Chula Vista, CA). Weld. Res. Counc. Bull.; No. 196, 1-60(Jul 1974).

Electron-beam equipment is considered along with fixed and mobile electron-beam guns, questions of weld environment, medium and nonvacuum welding, weld-joint designs, tooling, the economics of electron-beam job shops, aspects of safety, quality assurance, and repair. The application of the process in the case of individual materials is discussed, giving attention to aluminum, beryllium, copper, niobium, magnesium, molybdenum, tantalum, titanium, metal alloys, superalloys, and various types of steel. Mechanical-property test results are examined along with the areas of application of electron-beam welding. (IAA)

26584 IRIDIUM–HAFNIUM ALLOY. Inouye, H.; Liu, C. T. (to U. S. Energy Research and Development Administration). US Patent 3,918,965. C22C5/04. 11 Nov 1975. Filed date 26 Apr 1974. 4p.

PAT-APPL-464,429.

A new iridium alloy is described comprised of about 1 weight percent hafnium which greatly improves physical and mechanical properties as compared with pure iridium.

26585 PRECISE CARBON CONTROL OF FABRICATED STAINLESS STEEL. Nilsen, R. J. (to U. S. Energy Research and Development Administration). US Patent 3,925,109. C23C11/12; G21C3/34. 9 Dec 1975. Filed date 29 Jan 1974. 6p.

PAT-APPL-438,148.

A process is described for controlling the carbon content of fabricated stainless steel components including the steps of heat treating the component in hydrogen atmospheres of varying dewpoints and carbon potentials.

26586 NONSWELLING ALLOY. Harkness, S. D. (to U. S. Energy Research and Development Administration). US Patent 3,928,027. C22C21/12. 23 Dec 1975. Filed date 20 Aug 1974. 4p.

PAT-APPL-499,104.

An aluminum alloy containing one weight percent copper has been found to be resistant to void formation and thus is useful in all nuclear applications which currently use aluminum or other aluminum alloys in reactor positions which are subjected to high neutron doses.

26587 METHOD FOR TREATING REACTIVE METALS IN A VACUUM FURNACE. Hulsey, W. J. (to U. S. Energy Research and Development Administration). US Patent 3,915,695. C22B60/04; C22B60/02; C22B34/00. 28 Oct 1975. Filed date 8 Jan 1974. 4p.

PAT-APPL-431,819.

The invention is directed to a method for reducing the contamination of reactive metal melts in vacuum furnaces due to the presence of residual gaseous contaminants in the furnace atmosphere. This reduction is achieved by injecting a stream of inert gas directly over the metal confined in a substantially closed crucible with the flow of the gas being sufficient to establish a pressure differential between the interior of the crucible and the furnace atmosphere.

26588 DISPERSION-HARDENED HIGH-TEMPERATURE RESISTANT MATERIALS. Unckel, H. Metall; 29: No. 10, 1007-1014(Oct 1975). (In German)

8 figs.; 77 refs.

The need for materials with ever increasing high-temperature strength has universally stimulated research into dispersion hardening. A survey is given on what has been attained concerning the most important groups of alloys on aluminium, copper, and nickel bases. A number of the new materials are already employed and much more is expected in this field, regarding for instance, cheaper manufacture and development of the as yet unsatisfactory theoretical interpretation. (DE)

26589 GENERAL THEORETICAL CONSIDERATIONS ON ELECTRON BEAM BOMBARDMENT. Gabbay, M. pp 1-1–1-46 of Industrial Applications of Electron Beam Bombardment. Lyon, France; Institut National des Sciences Appliquees (1972). (In French)

From information meeting on the industrial applications of electron beam bombardment; Lyon, France (22 Nov 1972).

Theoretical data on electron beams are given: power density, electron emission, etc. The electron beam production system of most of industrial equipments is described including the electron gun and focusing system. (FR)

26590 ELECTRON BEAM WELDING. Gabbay, M. pp 2-1–2-39 of Industrial Applications of Electron Beam Bombardment. Lyon, France; Institut National des Sciences Appliquees (1972). (In French)

From information meeting on the industrial applications of electron beam bombardment; Lyon, France (22 Nov 1972).

The bead characteristics and the possible mechanisms of the electron beam penetration are presented. The different welding techniques are exposed and the main parts of an electron beam welding equipment are described. Some applications to nuclear, spatial and other industries are cited. (FR)

26591 MELTING AND PURIFICATION OF REACTIVE AND REFRACTORY METALS AND ALLOY STEELS USING THE ELECTRON BEAM BOMBARDMENT METHOD. Actual Technique and Future Outlook. Stephan, H. (Leybold-Heraeus G.m.b.H. und Co. K. G.; Koeln (F. R. Germany)). pp 6.1-6.52 of Industrial Applications of Electron Beam Bombardment. Lyon, France; Institut National des Sciences Appliquees (1972). (In French)

From information meeting on the industrial applications of electron beam bombardment; Lyon, France (22 Nov 1972).

The applications of electron beam bombardment to metallurgy are presented: production, purification, and quality improvement of reactive and refractory metals and alloy steels. The distribution and performances of the electron beam melting furnaces in the world are given. (FR)

26592 A METHOD FOR MANUFACTURING MONOCRYSTALS. Faure, J.; Malmejac, Y.; Schaub, B. (to CEA, 75–Paris (France)). French Patent 2,231,426/A/. 30 May 1973. 7p. (In French)

Description is given of a method for manufacturing monocrystals, substantially free of disorder, of a metal showing an allotropic transformation at a temperature lower than its melting point. Monocrystals of the raw metal having undergone a unidirectional solidification are heated to a temperature between the allotropic transformation point and the metal melting point; the monocrystals are maintained in the vicinity of that temperature for a given period of time; they are cooled down to a temperature lower than the allotropic transformation point, then they are annealed and cooled down to room temperature. Such monocrystals are used in neutron monochromators. (FR)

26593 PLASMA SPRAYED SAMARIUM–COBALT PERMANENT MAGNETS. Willson, M. C.; Janowiecki, R. J. pp 689-690 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

Samarium–Co permanent magnets were fabricated by arc plasma spraying. This process involves the injection of relatively coarse powder particles into a high temperature gas for melting and spraying onto a substrate. The technique is being investigated as an economical method for fabricating Co–rare earth magnets for advanced traveling wave tubes and cross-field amplifiers. Plasma spraying permits deposition of material at high rates over large areas with optional direct bonding to the substrate, and offers the ability to fabricate magnets in a variety of shapes and sizes. Isotropic magnets were produced with high coercivity and good reproducibility in magnetic properties. Post-spray thermal treatments were used to enhance the magnetic properties of sprayed deposits. Samarium–Co magnets, sprayed from Sm-rich powder and subjected to post-spray heat treatment, displayed energy products in excess of 9 million G-Oe and coercive forces of approximately 6000 Oe. Bar magnet arrays were constructed by depositing magnets on ceramic substrates. (Metals Abstr.)

26594 INFLUENCE OF OXYGEN PARTIAL PRESSURE ON Cd-, Se-, AND CdSe-LAYER FORMATION. I. Derivation of Basic Relations and Selection of Suitable Materials for the Experiment. Hamersky, J. (Forschungsinstitut fuer Elektrotechnische Keramik, Hradec Kralove, Czech.). Thin Solid Films; 29: No. 2, 237-248(Oct 1975). (In German).

The oxidation of materials during vacuum deposition of layers is dependent on the mobility of the molecules of the deposited film on the substrate and their reaction properties. The method we have used is particularly suitable for materials which oxidize well. For other materials this method shows that it is possible for single compounds to form and it gives the condition for the preferential formation of single components. The general derivation is applied respectively to Cd, Se and CdSe and in each case the special problems presented by the character of the material are considered. (auth)

26595 METHOD FOR SPECIFYING HOT ISOSTATIC PRESSURE WELDING PARAMETERS. Bryant, W. A. (Westinghouse Astronuclear Labs., Pittsburgh). Weld. J. (N. Y.); 54: No. 12, 433s-435s(Dec 1975).

A procedure for graphically presenting the minimum pressure and temperature required for hot isostatic pressure welding of metals and alloys is described. The use of one such graph for specifying weld parameters is demonstrated and is found to be reasonably accurate. (auth)

26596 USES OF WELDED MATERIALS IN NUCLEAR POWER ENGINEERING. Nichols, R. W. (UKAEA Engineering and Materials Lab., Risley). Weld. J. (N. Y.); 54: No. 12, 417s-432s(Dec 1975).

From 56th AWS annual meeting; Cleveland, OH, USA (21 Apr 1975).

Methods of developing high reliability in weldments of reactor structural components are reviewed. Discussions are included on welding process developments, weld cracking, properties of weldments, process quality control, in-service inspection, and in-service repair. Examples of reliability monitoring in all stages of design, fabrication, and operation of welded components are included. (JRD)

26597 RESISTANCE WELDING PRECIOUS METAL CONTACTS FOR MINIATURE WIRE SPRING RELAYS. Dankof, L. L. (Western Electric Co., Omaha, NE). Weld. J. (N. Y.); 54: No. 12, 872-878(Dec 1975).

From 23rd annual national relay conference; Stillwater, OK, USA (29 Apr 1975).

Fabrication of miniature Cu–Be wire spring relays is described. Resistance welding processes are described along with equipment development and engineering problems. (JRD)

26598 RARE EARTH INTERMETALLIC COMPOUNDS PRODUCED BY A REDUCTION-DIFFUSION PROCESS. Cech, R. E. (to General Electric Co.). US Patent 3,928,089. 23 Dec 1975. Filed date 24 Jul 1974. 8p.

A reduction-diffusion process is given for producing novel rare earth intermetallic compounds, such as cobalt–rare earth intermetallic compounds, especially compounds useful in preparing permanent magnets. A particulate mixture of rare earth metal halide, cobalt and calcium hydride is heated to effect reduction of the rare earth metal halide and to diffuse the resulting rare earth metal into the cobalt to form the intermetallic compound. (Official Gazette)

Properties, Structure, and Phase Studies

Refer also to abstracts 25830, 25833, 25860, 26497, 26672, 26846, 26927, 27559, 27567, 27984, 28046, 28048, 28049, and 28130.

26599 (AD/A-007141) STRAIN RATE EFFECTS IN BRITTLE AND TOUGH MATERIALS. Final Report. Mardirosian, M. M. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Dec 1974. 41p. (AMMRC-TR-74-34). NTIS $3.75.

Strain rate sensitivity effects and strain hardening characteristics at room, elevated, and subzero temperatures were evaluated for a wide variety of both tough and brittle materials including 4340, 52100, and HF-1 steels, 6Al-4V and 6Al-6V-2Sn titanium alloys and the 8Mo-½ Ti uranium alloy. Mechanical property parameters such as true stress, true strain, true fracture stress, ultimate and yield strengths, tension modulus, and reduction of area are examined under a temperature environment ranging from -116 to +260°C over a strain rate spectrum of 0.001/sec to 500/sec. (GRA)

26600 (AED-CONF-74-538-039) INFLUENCE OF TEMPERATURE AND TENSILE STRESS CYCLES CAUSED BY WELDING ON THE FORMATION OF CRACKS IN THE HEAT-AFFECTED ZONE OF A PRESSURE VESSEL STEEL. Theis, K.; Eichhorn, F. 1974. 9p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

12 figs.; 33 refs. Available from ZAED. Special print of DVS-Bericht v. 32, Deutscher Verl. f. Schweisstechnik, Duesseldorf.

Investigations were made with the photoemission electron microscope. Direct observations of the transformation of the structure and the formation of cracks, dependent on temperature and tensile stress, were made in specimens of 22 NiMoCr 37. (DE)

26601 (AED-CONF-74-538-041) MICROSTRUCTURE OF BRAZED JOINTS MADE OF HEAT RESISTING MATERIALS WITH FILLER METALS ON Ni-Cr-BASIS AND THEIR INFLUENCE ON DUCTILITY OF THE JOINTS. Paoli, A. de; Colbus, J. 1974. 7p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

17 figs.; 11 refs. Available from ZAED.

Microstructure of the brazed joints, influence of joint gap and heat treatment, impact strength of notched and unnotched brazed joints, and dependence on specimen thickness and hammer velocity are considered. (DE)

26602 (AED-CONF-74-538-042) CRACKING SUSCEPTIBILITY OF HIGH TEMPERATURE BRAZED JOINTS. Draugelates, U.; Steffens, H. D.; Wielage, B. (Fraunhofes-Gesellschaft zur Foerderung des Angewandten Forschung e.V., Bremen (F. R. Germany). Inst. fuer Angewandte Materialforschung). 1974. 5p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

Available from ZAED.

Results of fracture mechanics investigations are discussed on $NiCr^{20}TiAl$-specimens brazed at high temperature with the filler metal NiCrSi-NB 30, special specimen form, comparison of the stress intensity factor of base metal and brazed joints, and recommendations for practice are reported. (DE)

26603 (ANCR-1292) REVIEW OF THE PHYSICAL METALLURGY OF ALLOY 718. Keiser, D. D.; Brown, H. L. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1976. Contract E(10-1)-1375. 27p. Dep. NTIS $4.00.

The physical metallurgy of Alloy 718 is updated to 1976 on the basis of a survey of post-1967 literature and current experimental data. Composition, microstructures, and mechanical properties are correlated with heat treatment parameters. The current state of understanding of phase stability, strengthening mechanisms, deformation modes, recovery, and recrystallization in this material is described.

26604 (BNWL-SA-5445) METASTABLE A-15 PHASE SUPERCONDUCTORS TRANSFORMED FROM METASTABLE BCC Nb_3 X SOLID SOLUTIONS MADE BY HIGH-RATE SPUTTER DEPOSITION. Wang, R.; Dahlgren, S. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 8p. (CONF-751172-3). Dep. NTIS $3.50.

From second international conference on rapidly quenched metals; Cambridge, Massachusetts, United States of America (USA) (17 Nov 1975)

In the course of synthesis of superconductive alloys up to 1 mm thick by high-rate sputter deposition, metastable bcc phases of Nb_3Al, Nb_3Sn, Nb_3Ge, Nb_3(AlGe), and Nb_3Si were obtained. This paper reports our study of the phase transformation of metastable bcc solid solutions by heat treatment. The grain sizes of the as-deposited bcc phases depended on deposition temperature. For depositions made at approximately 10°C, large variations of grain size were observed among the materials, e.g. approximately 1000 A for Nb_3Al and Nb_3Sn, approximately 50 A for Nb_3Ge, Nb_3(AlGe), and Nb_3Si. All bcc phases transformed to the A-15 phase at approximately 650°C within 24 hours except for Nb_3Si, which transformed into a tetragonal phase at approximately 750°C. The grain size of the A-15 phase was approximately three to five times the initial grain size of the bcc phase. The phase transformations in Nb_3(AlGe) and Nb_3Si were described by tentative time-temperature-transformation diagrams. Transmission electron microscopic investigation of the bcc yields A-15 transformation for Nb_3Al shows the presence of both coherent and incoherent type precipitates in the early stages of transformation. (auth)

26605 (BNWL-SA-5603) SOLUBILITY AND STABILITY OF LIQUID-QUENCHED METASTABLE HCP SOLID SOLUTIONS. Wang, R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 9p. (CONF-751172-1). Dep. NTIS $3.50.

From 2nd international conference on rapidly quenched metals; Cambridge, Massachusetts, United States of America (USA) (17 Nov 1975).

This paper shows that simple crystal chemistry rules may be applied to interpret and predict the solubility limit and phase stability of alloys at nonequilibrium conditions. Twenty-nine liquid-quenched metastable hcp solid solutions containing elements with both bcc and hcp allotropic forms were studied. Hcp solid solutions of Group III elements with Ti, Zr, and Hf obtained by splat cooling showed that the metastable solubility limits were semiquantitatively correlated to the size factors and c/a ratios. TEM studies indicated that the extended solubilities results from trapping of extra solute in the alpha' martensite matrices during L yields beta yields alpha' transformation. Hcp intra-rare earth solid solutions were controlled by the structural metastability, e.g. these hcp phases were all terminated at c/a ratios near 1.597. Thus, the linear correlation of the c/a deviation from ideality and phase stability proposed by Hodges was demonstrated. The solubility limit and structure stability for liquid-quenched metastable hcp phases, as well as the implication for the equilibrium solubility limits, are discussed. (auth)

26606 (CEA-N-1817(Suppl.), pp 40-41) STUDY OF THE MAGNETIZATION DENSITY IN YCo_5 AND Y_2Co_{17} INTERMETALLIC COMPOUNDS. Schweizer, J.; Tasset, F. 1975. (In French)

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin No. 7, January–June 1975. ILL experiments. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

A study using monopolarized neutrons allowed the real structure of a YCo_5 monocrystal to be determined. A polarized neutron study allowed the measurement of magnetic structure factors, spin distribution anisotropy, and the magnetization density (−0.05 μ(B)/A) outside the magnetic sites. The compound Y_2Co_{17} whose structure was refined using X radiations slightly differs from YCo_5. (FR)

26607 (CNRS-CPT-74-P-639, pp 150-161) CRITICAL PHENOMENA IN FERROMAGNETIC SPIN SYSTEMS ON LATTICES. Zinn-Justin, J. 1974.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28 1974. (European Organization for Nuclear Research, Geneva (Switzerland); CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique Theorique).

A perturbation expansion of the partition function, for a spin system on a lattice, is used in order to justify the renormalization group equations satisfied by the correlation functions in the critical domain of a second-order phase transition. These renormalization group equations correspond to a field theoretical formulation of Wilson's theory of critical phenomena. (FR)

26608 (CONF-760209-11) STRESS DISTRIBUTION IN HELIUM-ION IMPLANTATIONS. Hall, B. O. (Argonne National

Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 19p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

The stress introduced into a material in a monoenergetic helium-ion implantation is calculated for an ion beam with a gaussian intensity distribution. An effective beam spot of the order of several millimeters was chosen as typical of blistering experiments. The sample is assumed to be semi-infinite and isotropic. The ion distribution is cylindrically symmetric with a gaussian depth profile. The parameters defining the distribution are consistent with incident ion energies of approximately 40 and approximately 400 keV in both nickel and niobium. The volume expansion caused by the implanted ions is assumed to be proportional to the local helium concentration; the validity of this assumption is discussed. The maximum shear stress is calculated as a function of depth, and the volume expansion per helium atom required to produce plastic deformation at the experimentally observed critical doses in niobium is found to be of the order of one atomic volume.

26609 (FRNC-TH-565) ELECTRONIC STRUCTURE AND MAGNETIC PROPERTIES OF ACTINIDES. Fournier, J. M. (Grenoble-1 Univ., 38 (France)). 1975. vp. (In French). INIS.

The study of the actinide series shows the change between transition metal behavior and lanthanide behavior, between constant weak paramagnetism for thorium and strong Curie-Weiss paramagnetism for curium. Curium is shown to be the first metal of the actinide series to be magnetically ordered, its Neel temperature being 52K. The magnetic properties of the actinides were studied in relation to all the peripheral electrons and their electronic structure determined by means of a phenomenological model. Attempts were also made to interrelate the different physical properties which depend on the outer electronic structure. (FR)

26610 (JUL-1211) HYDROGEN DIFFUSION IN METALS. Kehr, K. W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung; Koeln Univ. (F. R. Germany). Mathematisch-Naturwissenschaftliche Fakultaet). Jun 1975. 149p. (In German). INIS.

26 figs.; 4 tabs.; with refs.

The theoretical picture of the diffusion of light interstitials is reviewed and compared by experiment. Possible quantum effects are discussed. First experimental results for the diffusion constants of H, D, and T in low concentrations in the transition metals, V, Nb, Ta, Ni, and Pd are reviewed. The classical and quantum-mechanical theories of the single jumps of interstitials are presented. Several extensions of theories of the diffusion of light interstitials are examined. The information which can be obtained from quasielastic incoherent neutron scattering is considered in detail. (DE)

26611 (JUL-1214) THE DETERMINATION OF PINNING FORCES FOR FLUX LINES IN SUPERCONDUCTORS BY NEUTRON DIFFRACTION. Lippmann, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung; Bochum Univ. (F. R. Germany)). Jul 1975. 68p. (In German). INIS.

Neutron diffraction experiments by flux line lattices in niobium samples at 4.2°K are reported. The samples contained non-superconducting Nb_2N-precipitates in various concentrations, which act as pinning centers. The pinned flux lines are not exactly parallel to each other as they would be in an ideal type-II superconductor but are tilted by small angles with respect to the external field. This angular tilt results in a broadening of the Bragg reflections in the direction of the flux lines, which is measured by recording rocking curves. The characteristic parameter of the rocking curves is their full width at half maximum; it varied with precipitate concentration and flux density and ranged from 6′ to 250′. (DE)

26612 (ORNL-5078, pp 51-139) MATERIALS DEVELOPMENT. McCoy, H. E. Feb 1976.

In molten-salt reactor program. Semiannual progress report for period ending August 31, 1975. (Oak Ridge National Lab., Tenn. (USA)).

The main thrust of the materials program is the development of a structural material for the MSBR primary circuit which has adequate resistance to embrittlement by neutron irradiation and to shallow intergranular attack by fission product penetration. A modified Hastelloy N containing 2 percent Ti has good resistance to irradiation embrittlement; however, it remains to be shown that the alloy has sufficient resistance to shallow intergranular cracking. Numerous laboratory tests are in progress to answer this important question. Laboratory programs to study Hastelloy N–salt–tellurium interactions are being established, including the development of methods for exposing test materials under simulated reactor operating conditions. The procurement of products from two commercial heats (8000 and 10,000 lb) of 2 percent Ti–modified Hastelloy N continued. All products except seamless tubing were received, and much experience was gained in the fabrication of the new alloy. The work on chemical processing materials is concentrated on graphite. Capsule tests are in progress to study possible chemical interactions between graphite and bismuth-lithium solutions and to evaluate the mechanical intrusion of these solutions into the graphite. (JRD)

26613 (ORO-4044-6) TECHNICAL PROGRESS REPORT ON STUDIES ON MICROSTRUCTURE-PROPERTY RELATIONSHIPS IN AUSTENITIC STAINLESS STEELS, JANUARY 1, 1975–DECEMBER 31, 1975. Spruiell, J. E. (Tennessee Univ., Knoxville (USA)). 1976. Contract AT(40-1)-4044. 36p. Dep. NTIS $4.00.

Research progress is reported in programs on microstructural stability of stainless steels. Results of studies are summarized on time-temperature-precipitation in 316 and 321 stainless steels, phase formation in austenitic stainless steels, corrosion behavior of austenitic stainless steels and weld metals, and cold work and recovery in austenitic stainless steels. (JRD)

26614 (UCR-34P77-47) ELECTRIC AND MAGNETIC PROPERTIES OF TRANSITION METALS AND THEIR COMPOUNDS. (Energy Research and Development Administration, Washington, D. C. (USA)). 1 Feb 1976. Contract AT(04-3)-34. 44p. Dep. NTIS $4.00.

Results of studies on the electric and magnetic properties of transition metals and their compounds are presented in sections on rare earth metals, rare earth compounds, and transport properties of IrO_2, RuO_2, and related materials. (JRD)

26615 (UCRL-50028-75-2, pp 1-15) THEORETICAL EOS GROUP. 1975.

In H-Division quarterly report, April-June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Efforts devoted to the development of theoretical techniques for the description of materials properties under extreme conditions are summarized along with work on the construction of equation of state (EOS) tables for specific materials. Results of research are reported on EOS of high Z materials, EOS of atomic iodine, computer methods for EOS data, EOS of solid metallic H, universal form for fluids governed by power inverse power potentials, and EOS for Cs shock compression experiment analysis. (JRD)

26616 (UCRL-50028-75-2, pp 22-28) EXPERIMENTAL EOS GROUP. 1975.

In H-Division quarterly report, April–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Research on the properties of materials at high pressures and temperatures is reported. Results of experiments are presented on equation of state (EOS) of sapphire, quartz, polycarbonate and granite. Results of isobaric expansion experiments on U and W at 6000°K are also presented. (JRD)

26617 (UCRL-50028-75-2, pp 29-38) DYNAMIC MATERIALS RESPONSE GROUP. 1975.

In H-Division quarterly report, April–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Results of research on the response of materials to a wide range of pressure, time, and temperature are reported. Results of studies are summarized on tamped impulses, time-resolved impulse gages for underground testing, armor design for defense against long rod penetrators, advanced armor design, and properties of porous materials. (JRD)

26618 (UCRL-51902) PHASE DIAGRAMS OF THE ELEMENTS. Young, D. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1975. Contract W-7405-eng-48. 68p. Dep. NTIS $5.45.

A summary of the pressure-temperature phase diagrams of the elements is presented, with graphs of the experimentally determined solid-solid phase boundaries and melting curves. Comments, including theoretical discussion, are provided for each diagram. The crystal structure of each solid phase is identified and discussed. This work is aimed at encouraging further experimental and theoretical research on phase transitions in the elements. (auth)

26619 INTERMETALLIC COMPOUNDS OF YTTRIUM AND HAFNIUM WITH PLATINUM. Holcombe, C. E. Jr. (Union Carbide Corp., Oak Ridge, TN). J. Less-Common Met.; 44: 331-335(Jan 1976).

Preparation and structure of YPt_5, and $HfPt_3$, and $HfPt_5$ were investigated. Resulting data on physical properties and x-ray diffraction patterns for these compounds are given. It is noted

that because of the high melting points and stabilities of high-Pt-content compounds such as $HfPt_3$ and $HfPt_5$, they may be used to contain reactive oxides in high-temperature x-ray diffraction experiments. (JRD)

26620 PHASE BOUNDARIES AND THERMODYNAMIC ANALYSIS OF THE RARE-EARTH-RICH ALLOYS IN THE La–Tl AND Pr–In SYSTEMS. McMasters, O. D.; Gschneidner, K. A. Jr. (Ames Lab., IA). J. Less-Common Met.; 44: 281-289(Jan 1976).

The phase boundaries in the rare-earth-rich portions of the lanthanum–thallium and praseodymium–indium systems were determined using differential thermal methods. The solid solubility of Tl in bcc gamma-La is 11.0 at. percent at the 655°C eutectic temperature and that in fcc beta-La is 1.9 at. percent at the 640°C eutectoid temperature. The solid solubility of In in bcc beta-Pr is 9.8 at. percent at the 825°C eutectic temperature while that in dhcp alpha-Pr is 5.6 at. percent at the 725°C eutectoid temperature. The first La-rich compound, La_3Tl, decomposes peritectoidally at 645°C and La_2Tl melts peritectically at 900°C. The compound Pr_3In decomposes peritectically at 930°C. The thermodynamic analyses data for these alloys were compared with those reported for the La–In and Pr–Tl systems. (auth)

26621 SUPERCONDUCTIVITY IN THE TECHNETIUM–TITANIUM ALLOY SYSTEM. Koch, C. C. (Oak Ridge National Lab., TN). J. Less-Common Met.; 44: 177-181(Jan 1976).

A survey of superconducting transition temperatures and crystal structures has been made for the Tc–Ti alloy system. The highest transition temperature in this system (10.89°K) occurs in the hcp technetium-rich solid solution. The Tc–Ti system is qualitatively similar to the Re–Ti system and follows the generally observed dependence of transition temperatures on average group number and crystal structure. (auth)

26622 SUPERCONDUCTING WEAK-LINK CURRENT-PHASE RELATIONS. Jackel, L.D.; Warlaumont, J.M.; Clark, T.D.; Brown, J.C.; Buhrman, R.A. (School of Applied and Engineering Physics, Cornell University, Ithaca, New York 14853); Levinsen, M.T. Appl. Phys. Lett. 28: No. 6, 353-355 (15 Mar 1976).

Direct measurements have been made of the current-phase relation (CPR) of photolithographic tin microbridges, scribed indium microbridges, proximity bridges, and point contacts. Hysteretic current-phase relations have been observed in uniform-thickness tin microbridges, while proximity bridges have sinusoidal or nearly sinusoidal current-phase relations. (auth)

26623 MAGNETIC PROPERTIES OF AMORPHOUS Gd-Fe FILMS PREPARED BY EVAPORATION. Taylor, R.C. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 47: No. 3, 1164-1167 (Mar 1976).

Amorphous Gd_xFe_{1-x} films with $0.18<x<0.33$ were prepared by electron-beam coevaporation of the elements. The composition dependence of anisotropy and the composition and temperature dependence of saturation magnetization of the films were studied. In contrast to evaporated Gd-Co films, where anisotropy is in-plane, the Gd-Fe films were found to have strong perpendicular anisotropy with the uniaxial anisotropy constant (K_u) decreasing monotonically from 3.8×10^5 erg/cm³ at $x=0.18$ to 2.0×10^5 erg/cm³ at $x=0.33$. The perpendicular anisotropy field (H_K) reached a maximum at the compensation composition ($x=0.26$) and fell off rapidly on both sides. The findings suggest that anisotropy in evaporated films is due to a longer-range structural ordering than the pair ordering which is assumed to exist in sputtered films. Saturation magnetization measurements showed that magnetization of the amorphous alloys could be closely approximated from the moments of pure crystalline Gd and Fe. The 0°K moment of Fe was found to be $2.20\mu_B$ ($0.23<x<0.31$) suggesting less charge transfer than in crystalline $GdFe_3$. Q values ($H_K/4\pi M_s$) of the alloys exceeded unity in the range $0.19<x<0.31$. (auth)

26624 CHEMISORPTION-INDUCED SURFACE UMKLAPP PROCESSES IN ANGLE-RESOLVED SYNCHROTRON PHOTOEMISSION FROM W(001). Anderson, J.; Lapeyre, G.J. (Montana State University, Bozeman, Montana 59715). Phys. Rev. Lett. 36: No. 7, 376-379 (16 Feb 1976).

Angle-resolved photoemission, using synchrotron radiation, from the chemisorption system W(001)+H shows a very large doublet of peaks at initial energies −1.3 and −0.6 eV for quarter-monolayer coverage which disappear at higher coverage. The emission lobes are strongly peaked in the ⟨110⟩ azimuths and are attributed to essentially pure bulk W transitions. The electrons are emitted in the new directions through the influence of "extra" surface reciprocal lattice vectors associated with the hydrogen C (2×2) superstructure. (auth)

26625 JOSEPHSON OSCILLATION OF A MOVING VORTEX LATTICE. Martinoli, P.; Daldini, O.; Leemann, C.; Van den Brandt, B. (Laboratorium für Festkörperphysik, Eidgenössische Technische Hochschule Zürich, CH-8049 Zürich, Switzerland). Phys. Rev. Lett. 36: No. 7, 382-385 (16 Feb 1976).

Experimental evidence is presented for a supercurrent oscillation arising from vortex motion in the flux-flow regime of superconducting films with periodically modulated thickness. An essential condition for detecting the rf electric field associated with the oscillation is matching of the vortex lattice to the periodic pinning structure represented by the thickness modulation. (auth)

26626 NO GIANT TWO-ION ANISOTROPY IN THE HEAVY-RARE-EARTH METALS. Lindgård, P. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. Lett. 36: No. 7, 385-388 (16 Feb 1976).

A new Bose-operator expansion of tensor operators is applied to the heavy-rare-earth metals. The Er data for the cone phase have been analyzed successfully with single-ion anisotropy and isotropic exchange interaction. The Tb data can be understood on the same basis. The previously found large two-ion anisotropy was due to an inadequate treatment of the large single-ion anisotropy leading to an incorrect expression for the spin-wave energy. (auth)

26627 IMPROVING THE OPACITY OF PHASE-SEPARATED OPAL GLASSES BY ALTERATIONS OF THE INTERFACIAL TENSION. Flannery, J. E.; Dumbaugh, W. H.; Carrier, G. B. (Corning Glass Works, NY). Am. Ceram. Soc. Bull.; 54: No. 12, 1066-1068(Dec 1975).

From 75th annual meeting of the American Ceramic Society; Cincinnati, OH, USA (1 May 1973).

The size and shape of the separated, or opacifying phase, are major parameters in determining the opacity of an opal glass. Addition of known surface tension modifiers such as Li_2O and MoO_3 to a base glass showed that opacity can be increased. Electron micrographs are used to show the relative changes in phase separation. The morphology of the separated phase is also changed, leading to increases in the chemical durability of the glasses studied. (auth)

26628 EFFECT OF A MAGNETIC FIELD ON THE SUPERCONDUCTIVITY OF SMALL SPHERICAL TIN PARTICLES. Morozov, Yu.G.; Naumenko, I.G.; Petinov, V.I. Sov. Phys.–Solid State 17: No. 8, 1504-1507 (Aug 1975).

The magnetization curves M (H) have been measured for isolated spherical tin particles 860, 1300, and 4760 Å in diameter near T_c. The theoretical M (H) dependence is compared with the experimental curves for particles with $r\ll\xi_0$. The actual size distribution of the particles in the samples was taken into account in calculating the theoretical curves. There is a good agreement between theory and experiment. For small particles, $H_c\sim r^{-3/2}$. Comparison of the experimental and theoretical temperature dependences of x/x_0 immediately yields λ_L: $\lambda_L=350\pm15$ Å. The value of T_c for the isolated particles studied agrees with the critical temperature for bulk tin. For particles 4760 Å in diameter the influence of temperature on the M (H) hysteresis was studied. It was found that the M (H) hysteresis appears at $r/\lambda\simeq2.29$. (auth)

26629 PSEUDODIPOLE EXCHANGE ANISOTROPY IN INTERMETALLIC RARE EARTH COMPOUNDS. Kazakov, A.A. (A.M. Gor'kii Ural State University, Sverdlovsk). Sov. Phys.–Solid State 17: No. 8, 1527-1528 (Aug 1975).

The Hamiltonian for indirect exchange between $3d$ and $4f$ electrons is calculated. The Hamiltonian contains pseudodipole anisotropic terms as well as isotropic terms. The distance dependence of the exchange energy may differ from that described by the Ruderman–Kittel function. The anisotropy changes the sign of the same elements in the rare series as those for which the sign is changed by the single-ion crystal anisotropy. (auth)

26630 STUDY OF THE CRYSTAL STRUCTURE OF Bi-In ALLOYS AFTER THE APPLICATION OF HIGH PRESSURE. Degtyareva, V.F.; Ponyatovskii, E.G. (Institute of Solid-State Physics, Academy of Sciences of the USSR, Chernogolovka). Sov. Phys.–Solid State 17: No. 8, 1593-1594 (Aug 1975).

X-ray diffraction is used to investigate the crystal structure of Bi-In alloys that have been kept at a pressure of 12–25 kbar and then "quenched." (AIP)

26631 EFFECT OF HEAT-TREATMENT VARIATIONS ON STRENGTH AND DUCTILITY OF CHROMIUM–MOLYBDENUM–VANADIUM STEELS DURING CREEP AT 550°C. Tipler, H. R. Met. Technol.; 2: No. 5, 206-219(May 1975).

The performance of Cr–Mo–V steels, as used for steam pipe work and turbine rotors in steam power generating plant, may be limited by a susceptibility to failure at low ductility, especially when heat treated to high strength levels. To investigate the ductility in creep conditions a study of the interrelation of heat treatment, microstructure, creep strength, rupture strength, rupture ductility, and fracture characteristics was made in commercially produced 0.5% Cr–0.5% Mo–0.25% V and 1% Cr–1% Mo–0.25% V steels tested at 550°C for times up to >20,000 h. The results show that the rupture strength and ductility can be

varied widely by changing the austenitizing temperature and the rate of cooling therefrom, and that a heat treatment at a high temperature (1300°C), given to simulate the microstructure in the vicinity of a weld, can produce very low creep-rupture ductility (<1%). Low ductility is associated with an intergranular fracture process resulting from nucleation and growth of cavities on grain boundaries, and detailed optical metallography of cavitation characteristics was carried out on creep-tested specimens of the two steels in conditions giving different creep behavior. The results of an examination of these specimens at various proportions of their life to rupture are discussed and the implications considered. (Metals Abstr.)

26632 ELECTRICAL CONDUCTIVITY OF HEAVILY DOPED AND COMPENSATED n-TYPE INDIUM ANTIMONIDE. Gershenzon, E. M.; Il'in, V. A.; Kurilenko, I. N.; Litvak-Gorskaya, L. B. Fiz. Tekh. Poluprov.; 9: No. 7, 1324-1329(Jul 1975). (In Russian)

The influence of compensation and magnetic field strength on the electrical conductivity of heavily-doped and compensated n-type InSb was studied by analyzing the temperature dependence of the resistivity at cryogenic temperature (1.6-77°K) in magnetic fields up to 40 kOe. The resistivity/temperature characteristics were unexpectedly complex, and an approximate analysis of their anomalous sections suggested that the jump conductivity proposed by Mott was by no means the only type of jump effect operative. The transfer of electrons to very distant centers played an appreciable part in the over-all effect. (Metals Abstr.)

26633 TRANSITORY HARDENING OF α-ZIRCONIUM BY AGING AFTER STRAIN. de Paula e Silva, E. M. Metalurgia (Sao Paulo); 30: No. 201, 537-540(Aug 1974). (In Portuguese)

Alloys of Kroll and Van Arkel Zr containing 1.5, 2.0 or 3.0 at.-% O were subjected to tensile tests at constant stress (6.5×10^{-3}/min) in a secondary vacuum (3 to 5.10^{-6} torr) or in a current of Ar at temperatures between ambient and 500°C. In each test the specimen was stressed to a certain strain value; the test was then interrupted and the specimen aged for a period of a few seconds to 5 min, either under stress or in the complete absence of stress; after aging the tensile test was resumed at the same temperature. A yield point was observed in the stress curve of some of the specimens after aging. Hardening was temporary: after the irregularity, the strain curve was located in the prolongation of the initial stress curve. The phenomenon was temperature sensitive and was observed at temperatures between 200 and 400°C. The amplitude of the yield point increased with aging time; for the times studied, a saturation effect was observed at the higher temperature. The variations of the yield point also depended on the purity of the specimen. The yield point was not observed in specimens containing >1.5% O. The results are discussed in terms of short-range pinning of dislocations by O atoms. (Metals Abstr.)

26634 STRUCTURE OF $SmCo_{5-x}Cu_x$ ALLOYS. Malakhov, G. V.; Pashkov, P. P. Tr. Vses. Nauchno-Issled. Inst. Elektromekh.; No. 40, 34-39(1974). (In Russian)

The structures were determined for $SmCo_{5-x}Cu_x$ alloys for $0 < x \leq 2.7$ in respect of their magnetic properties and heat treatments. The dependence of lattice parameters on Cu content was determined for $SmCo_5$–$SmCu_5$ solid solutions. For x = 1.5 to 2.0 the alloys have high values of H_c and magnetic energy, and are used for permanent magnets. With $x \leq 2.0$ the alloys become single phase after homogenization and subsequent quenching from 1000°C. With higher Cu contents the alloys consist of two isomorphous phases of which one is enriched in $SmCu_5$. Tempering (after quenching) at 350 to 800°C leads to solid-solution breakdown into two isomorphous phases. The dispersed products from this latter process cause diffuse scattering on the x-ray patterns. The results of these studies are applied to the selection of Sm–Co–Cu alloy compositions and heat treatments for the production of high-coercivity cast magnets. (Metals Abstr.)

26635 LAYERING OF THE SOLID SOLUTION IN THE (Co, Ni)$_5$Sm ALLOY. Erastova, V. M.; Fridman, A. A.; Pashkov, P. P.; Malakhov, G. V. Tr. Vses. Nauchno-Issled. Inst. Elektromekh.; No. 40, 53-57(1974). (In Russian)

The diffuse scattering of x-rays by $Co_{3.5}Ni_{1.5}Sm$ was studied in investigating layering in this alloy. Diffuse scattering is mainly due to atomic displacement, i.e. distortions around precipitates and of the actual precipitates; these distortions arise from differences in the lattice parameters of the breakdown product phases. The form of the diffuse scattering regions suggests the presence of elastic anisotropy in the material and the results indicate a minimum elastic modulus in the [101] and [111] directions. (Metals Abstr.)

26636 SUPERCONDUCTIVITY AND SPECIFIC HEAT OF TITANIUM BASE A15 ALLOYS. Junod, A.; Flukiger, R.; Muller, J. (Univ., Geneva). J. Phys. Chem. Solids; 37: No. 1, 27-31 (1976). (In French)

Experimental data on the superconducting transition temperature, and low temperature specific heat, together with x-ray investigations, are reported for binary and pseudo-binary compounds of Ti with the A 15-type structure. A "true" relative maximum of the coefficient of the electronic specific heat, γ, as well as the superconducting transition temperature, T_c, occurs in the $Ti_3Ir_{1-x}Pt_x$ system near x = 0.2. $Ti_3Ir_{0.8}Pt_{0.2}$ shows the lowest Debye temperature Θ_0, of all A 15-type compounds known to date. The anomalous temperature dependence of the lattice specific heat may be reproduced by a model phonon spectrum similar to that of Nb_3Sn. (auth)

26637 CHANNELING INVESTIGATION OF PROTON AND DEUTERON DAMAGE IN GERMANIUM. Mitchell, J. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Foti, G.; Howe, L. M.; Davies, J. A.; Campisano, S. U.; Rimini, E. Radiat. Eff.; 26: No. 3, 193-199(Oct 1975).

The amount of damage present in germanium (and silicon) following implants of 200 keV H^+ or 300 keV D^+ at temperatures between 40 and 300°K has been measured using the channeling technique. The damage level is observed to increase strongly with decreasing implantation temperature. Damage profiles were obtained from the data by considering various scattering mechanisms, including single and plural scattering and a steady increase approximation treatment. For equal dose implants, deuterons create considerably more damage in germanium than protons. The ratio of deuteron damage to proton damage is significantly greater than the ratio of energy deposited in nuclear events for the two ions. The results of isochronal anneals at temperatures from 40 to 325°K on Ge crystals implanted at 40°K are also reported. A strong annealing stage is observed around 175°K; this is in good agreement with previous optical absorption studies of proton damage in germanium. (auth)

26638 CHANGE IN THE DISLOCATION STRUCTURE OF MOLYBDENUM SUBJECTED TO FATIGUE [LOADING]. Terent'ev, V. F.; Kogan, I. S.; Orlov, L. G. Fiz. Met. Metalloved.; 40: No. 1, 199-202(Jul 1975). (In Russian)

Changes taking place in the dislocation structure of Mo samples subjected to fatigue loading at 20°C were studied by electron microscopy and correlated with the results of x-ray diffraction analysis and mechanical tests. Analysis of all these data clearly indicated that very little change took place in the dislocation structure in the interior of the polycrystalline samples; certainly no dislocation clusters favoring crack generation were created. All the changes in dislocation structure took place close to the surface, within a layer 5 to 15 μm thick, and this was the layer in which cracks tended to develop. (Metals Abstr.)

26639 STUDY OF THE LOCAL SYMMETRY PROPERTIES OF Dy IN THE METALLIC COMPOUND LaSb. Davidov, D. (Hebrew Univ., Jerusalem); Zevin, V.; Bloch, J. M.; Rettori, C. Solid State Commun.; 17: No. 10, 1279-1283(15 Nov 1975).

Electron spin resonance study of Dy in LaSb single crystal indicates appreciable angular variation of the ESR linewidth at X band frequency. The data are interpreted in terms of a random stress model with possible local tetragonal distortions. (auth)

26640 X-RAY STUDIES OF THE FINE STRUCTURE OF DEFORMED ZIRCONIUM. Voskresenskaya, L. A.; Petukhova, A. S. Nauchn. Tr., Gos. Nauchno-Issled. Proektn. Inst. Redkomet. Prom-sti.; No. 57, 5-8(1974). (In Russian)

Harmonic analysis of line profiles using an x-ray diffractometer was used to study: (i) microstresses and (ii) the coherent scattering regions of polycrystalline Zr in relation to the degree of deformation in rolling and across the thickness of the specimen. Up to ~20% deformation there is an increase in (i) with a decrease in (ii). (Metals Abstr.)

26641 NON-METALLIC INCLUSIONS IN TUNGSTEN SINGLE CRYSTALS. Shishkov, V. V.; Pikunov, M. V.; Bondarenko, E. A.; Strigina, N. L. Nauchn. Tr., Gos. Nauchno-Issled. Proektn. Inst. Redkomet. Prom-sti.; No. 57, 120-124(1974). (In Russian)

Electron microscopy was used to study the nature of non-metallic inclusions in W single crystals obtained by electron float zone melting. Both crystalline and amorphous inclusions occur. Inclusions extracted by C replicas from an unetched section are of circular shape indicating that they were present in the liquid metal. The high stability of such inclusions in the fused W in this method of single-crystal production is attributed to their small dimensions and to the action of surface tension forces. (Metals Abstr.)

26642 STRUCTURE OF TUNGSTEN SINGLE CRYSTALS PRODUCED BY ELECTRON FLOAT ZONE MELTING. Sidokhin, E. F.; Chupyatova, L. P.; Pikunov, M. V. Nauchn. Tr., Gos.

Nauchno-Issled. Proektn. Inst. Redkomet. Prom-sti.; No. 57, 111-120(1974). (In Russian)

X-ray diffraction topography was used to study the block and dislocation structure of W single crystals. Using zero restraint conditions an analysis was made of the Burgers vectors and the nature of the distribution of dislocations in crystals of different orientations. These data were then used to establish a mechanism for the formation of blocks of various types. (Metals Abstr.)

26643 LOW TEMPERATURE MAGNETIC STUDIES ON $Sm_{0.222}Co_{0.778-x}Al_x$. Oesterreicher, H. (Univ. of California, San Diego, La Jolla). Phys. Status Solidi (a); 32: No. 2, K127-K130 (16 Dec 1975).

The magnetic properties at 4.2°K of Sm_2Co_7 with partial substitution by Al were studied. It was found Sm_2Co_7 has outstanding room temperature permanent magnetic properties. This compound also has the potential to play an important part in the magnetic hardening of materials on the basis of $SmCo_5$. (JRD)

26644 HELIUM DESORPTION FROM A MOLYBDENUM SINGLE CRYSTAL. van Veen, A. (Technical Univ., Delft, Netherlands); van Gorkum, A. A.; Caspers, L. M.; Nihoul, J.; Stals, L.; Cornelis, J. Phys. Status Solidi (a); 32: No. 2, K123-K126 (16 Dec 1975).

Measurements of He desorption from Mo single crystals were made to obtain values for binding energies of He to vacancies. The binding energies are tabulated. The reduction of the He peak in the range $300 < T < 600$°K is caused by migration of the vacancies to sinks or by the annihilation of the vacancies by freely migrating self-interstitials. More accurate measurements are required for reaching a definite conclusion. (JRD)

26645 DISAPPEARANCE OF MAGNETIC ORDERING IN FINE GADOLINIUM PARTICLES. Morozov, Yu. G.; Kostygov, A. N.; Petinov, V. I.; Chizhov, P. E. (Inst. of Chemical Physics, Chernogolovka, USSR). Phys. Status Solidi (a); 32: No. 2, K119-K121(16 Dec 1975).

The effects of Gd particle size on their structure and magnetic properties were studied. It was found that the magnetic transition in particulate Gd is determined by particle size. The changes in structure of Gd particles are connected with the effects of their surface, the influence of which increases with decrease in particle size. (JRD)

26646 SLIP GEOMETRY OF TANTALUM AND TANTALUM ALLOYS. Nawaz, M. H. A.; Mordike, B. L. (Univ. of Liverpool). Phys. Status Solidi (a); 32: No. 2, 449-458(16 Dec 1975).

The deformation behavior of tantalum–rhenium, tantalum–niobium, electron beam melted tantalum, and ultra high vacuum annealed tantalum is studied at temperatures 77 to 293°K. The slip geometry, morphology, and yield stress is determined as function of orientation, temperature, and mode of deformation. Alloying is observed to promote slip on the m.r.s.s. plane and to inhibit anomalous slip. The expected orientation dependence of the yield stress is observed for asymmetry on {211} planes. The yield stress in tension is always lower than that in compression and this difference increases with alloy content. (auth)

26647 ORIENTATION DEPENDENCE OF DISLOCATION MULTIPLICATION IN MOLYBDENUM SINGLE CRYSTALS. Leiko, E. B.; Nadgornii, E. M. (Inst. of Solid State Physics, Chernogolovka, USSR). Phys. Status Solidi (a); 32: No. 2, 395-401(16 Dec 1975).

The multiplication of freshly introduced screw (or nearly screw) dislocations in different {112} ⟨111⟩ slip systems for four sample orientations ([110], [120], [130], [010]) is investigated in molybdenum single crystals by an etch pitting method after two sign-variable loadings at 300°K. The orientational dependence obtained for multiplication is interpreted in terms of the cross-slip effect. It is believed that the observed orientational dependence of multiplication may make a significant contribution into the orientational dependence of yield points in bcc metals. (auth)

26648 DIFFUSION OF INTERSTITIAL ATOMS IN ORDERED Pt_2Mo-TYPE ALLOYS. I. Goltsov, V. A.; Smirnov, L. I. (Donetsk Polytechnic Inst., Stalino, USSR). Phys. Status Solidi (a); 32: No. 2, 379-385(16 Dec 1975).

The tensor diagonal components of the diffusion coefficients for interstitial atoms in laminated superlattice structures of Pt_2Mo type are calculated. The crystal lattice is shown to be diffusively anisotropic if interstitial atoms interact mainly with the adjacent atoms of the alloy. When thermodynamic equilibrium exists, the degree of anisotropy is claimed to rise quickly with the decrease of temperature. (auth)

26649 NATURE OF INTRA-BAND PHOTOCONDUCTIVITY IN COMPENSATED n-TYPE INDIUM ANTIMONIDE. Gulyaev, Yu. V.; Listvin, V. N.; Potapov, V. T.; Chusov, I. I.; Yaremenko, N. G. Fiz. Tekh. Poluprov.; 9: No. 8, 1471-1477(Aug 1975). (In Russian)

The theory of intra-band photoconductivity in heavily-doped, compensated semiconductors, based on the assumption that the non-linear characteristics of these materials are mainly attributable to an activation mechanism, is generalized to the case of the dissipation of electron energy by scattering at optical phonons. In particular, most of the results of an experimental investigation into the photoconductivity of n-type InSb crystals at a wavelength of 4.7 mm and a temperature of 4.5 to 78°K agree satisfactorily with this theory. Results show that there is a certain optimum degree of compensation at which the photo-response and sensitivity of n-type InSb reach their maximum values; this degree has to be determined empirically for each case. (Metals Abstr.)

26650 THERMO-ELECTRIC AMPLIFICATION OF SOUND IN SEMICONDUCTORS [INDIUM ANTIMONIDE]. Epshtein, E. M. Fiz. Tekh. Poluprov.; 9: No. 8, 1584-1587(Aug 1975). (In Russian)

The thermo-electric amplification of sound in semiconductors is discussed theoretically; a current-free type of sound amplification may occur (the external circuit being open-circuited) for $ql \gg 1$ (q is the wave-number of the sound, l is the mean free path of an electron) under the influence of an applied temperature gradient. The threshold value of this temperature gradient is of the same order of magnitude as in a short-circuited sample, but depends very much on the electron-scattering mechanism and the sound frequency. Examples are given for n-type InSb at 77°K. (Metals Abstr.)

26651 CHEMICAL SPECIFICITY IN THE SURFACE DIFFUSION OF CLUSTERS: Ir ON W(211). Reed, D. A.; Ehrlich, G. (Univ. of Illinois, Urbana). Philos. Mag.; 32: No. 5, 1095-1099(Nov 1975).

Although the diffusion of tungsten and rhenium clusters over the (211) plane of tungsten has recently been found to be quite similar, a significant chemical specificity should be expected for cluster migration. Such specificity has now been established in quantitative measurements on iridium doublets diffusing on W(211). With tungsten and rhenium, dimers have a lower activation energy for diffusion than do single atoms. For iridium dimers, the situation is reversed: single atoms diffuse over a barrier of 51 ± 5 kJ mol^{-1}, compared to a barrier of 65 ± 6 kJ mol^{-1} for dimers. This, and differences in the diffusion dynamics, are shown to be a consequence of interactions specific to iridium adatoms. (auth)

26652 INFLUENCE OF THE SIZE ON THE SOFTENING OF LEAD IN THE SUPERCONDUCTING STATE. Gindin, I. A.; Starodubov, Ya. D.; Lebedev, V. P.; Gubin, N. S. (Physicotechnical Inst., Kharkov). Sov. Phys.–Solid State (Engl. Transl.); 17: No. 4, 766-767(Apr 1975).

Translated from Fiz. Tverd. Tela; 17: No. 4, 1190-1192(Apr 1975).

Creep tests were carried out on poly and monocrystalline Pb at 4.2°K. Results indicate that a reduction in the transverse cross sectional area increased the softening effect $\delta\epsilon_{ss}$. The complex dependence of $\delta\epsilon_{ss}$ on σ may be explained by the nature of creep in a deformed sample and by the multistage strain-hardening process. Results are in agreement with Natsik's fluctuation theory. (DLC)

26653 MAGNETIC SUSCEPTIBILITY OF DILUTE IRON–DYSPROSIUM ALLOYS. Boyarskii, L. A.; Zemerov, F. M.; Romanenko, A. I. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Sov. Phys.–Solid State (Engl. Transl.); 17: No. 4, 669-671(Apr 1975).

Translated from Fiz. Tverd. Tela; 17: No. 4, 1050-1054(Apr 1975).

The magnetic susceptibility of polycrystalline specimens of iron–dysprosium alloys containing 0.3 and 3 at.% iron was measured in the temperature range 150-300°K. It is shown that iron has no specific effect on the behavior of dysprosium in the vicinity of the Néel point. Rather, the observed increase in the critical index of susceptibility is associated with the total impurity content of the specimens. However, the paramagnetic susceptibility of dysprosium depends to a considerable extent on the iron concentration; in particular a weak ferromagnetic moment, equal to 0.4 μ_B/atom Fe, is found in the specimen containing 3 at.% iron. The electrical and magnetic properties in the critical range, measured on identical specimens, have been compared. (auth)

26654 MAGNETIC PROPERTIES OF RARE EARTH–MAGNESIUM COMPOUNDS (RMg_3). Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Met.; 44: 301-306(Jan 1976).

The RMg_3 compounds (R = La, Ce, Pr, Nd, Sm, Gd, Tb) were investigated by x-ray diffraction; the corresponding powder dif-

fractograms were indexed according to the cubic Fe_3Al type-structure. The magnetic properties of these compounds were studied in the range 4 to 300°K, with magnetic field strengths up to 18 kOe. The asymptotic Curie temperature was found to be negative for $CeMg_3$, $PrMg_3$, and $NdMg_3$ but positive for $GdMg_3$ and $TbMg_3$. The compound $SmMg_3$ proved to have Néel temperature $T_N = 6.5$°K, but no magnetic ordering was detected in $CeMg_3$, $PrMg_3$, and $NdMg_3$. The compounds $GdMg_3$ and $TbMg_3$ apparently order ferromagnetically. The much-too-low saturation moments for these compounds are an indication, however, of a more complex magnetic structure. The observed magnetic properties are in disagreement with an RKKY type description. It is suggested that 5d electrons may have some influence on the coupling between the rare-earth moments. (auth)

26655 MICROSTRUCTURE OF $SmCo_5$ SINTERED MAGNET MATERIAL. Riley, A. (Univ. of Salford, Eng.). J. Less-Common Met.; 44: 307-317(Jan 1976).

Using conventional (100 kV) and high (1 MV) voltage transmission-electron microscopy, the microstructure of hyperstoichiometric $SmCo_5$ magnet material has been examined. Second phase regions, investigated by electron-microscope microanalysis (EMMA), have been found to be either of composition close to Sm_3Co or SmCo. Sm_3Co is found both at grain boundaries and within the otherwise single-phase $SmCo_5$ grains, while the SmCo regions are found only at grain boundaries. If the precipitation of Sm_3Co near to grain boundaries in Sm-rich sinters is both typical of hyperstoichiometric magnets and a consequence of the ability of $SmCo_5$ to exist over a range of compositions at elevated temperatures, then a new basis is provided for explaining some of the observed magnetic properties. (auth)

26656 NONLINEAR EFFECTS OF SOUND PROPAGATION IN n-InSb AT 4.2°K. Ilisavskii, Yu, V.; Chiplis, D. (Ioffe Physicotechnical Inst., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 17: No. 4, 652-655(Apr 1975).

Translated from Fiz. Tverd. Tela; 17: No. 4, 1020-1026(Apr 1975).

The absorption of transverse acoustic waves and the effect thereon of longitudinal electric and magnetic fields are investigated in n-InSb at a temperature of 4.2°K over a wide range of frequencies and intensities. The electronic sound absorption is observed to have a strong dependence on the input intensity due to the heating of electrons by sound. It is found that the observed nonlinearity is suppressed by an electric field. It is inferred from a comparison of the experimental results with existing theories that, together with the variation of the carrier mobility, a variation of the carrier concentration in the conduction band is also significant in the acoustic heating of electrons. Results of measurements in a magnetic field are qualitatively consistent with the two-band conduction model. (auth)

26657 NIOBIUM-ALUMINUM BINARY SYSTEM PHASE EQUILIBRIA AT 1100°C AND SUPERCONDUCTIVITY OF ALLOYS. Kokot, L.; Horyn, R.; Iliew, N. (Inst. for Low Temperature and Structure Research, Wroclaw). J. Less-Common Met.; 44: 215-219(Jan 1976).

The 1100°C isothermal section of the Nb-Al binary system has been studied. The phase boundaries at 1100°C, and improved values of the lattice parameters of the Nb-Al phases, together with their superconducting properties, are presented. The Nb_2Al phase proved not to be a superconductor down to 4.2°K. (auth)

26658 NIOBIUM-ALUMINUM-IRIDIUM TERNARY SYSTEM. I. Phase Equilibria at 1100°C and Superconductivity of Alloys. Horyn, R. (Inst. for Low Temperature and Structure Research, Wroclaw). J. Less-Common Met.; 44: 221-227(Jan 1976).

The Nb-rich part of the Nb-Al-Ir ternary system has been investigated by x-ray diffraction methods and the phase equilibrium diagram of the 1100°C isothermal section has been determined. Three ternary, terminal solid solutions, based on the Nb_3Al, Nb_3Ir, and Nb crystal lattices, respectively, and one ternary, continuous solid solution of σ-type, constitute the phase relationships prevailing in this part of the system. The lattice parameters of the Nb-Al-Ir phases and their transition temperatures, T_c, are also presented. No phase with a T_c higher than that of Nb_3Al has been found. (auth)

26659 LANTHANUM-MERCURY SYSTEM. Bruzzone, G.; Merlo, F. (Univ., Genoa). J. Less-Common Met.; 44: 259-265(Jan 1976).

The lanthanum-mercury system has been studied by thermal- and x-ray analysis in the range 0 to 70 at.% La. The following compounds were found: LaHg (1078°C), $LaHg_2$ (1043°C), $LaHg_3$ (920°C), $LaHg_4$ (780°C), La_2Hg_9 ~ (660°C), and $LaHg_6$ ~ (288°C). Only two phases (1:1 and 1:2) melt congruently. A eutectic occurs at 41.0 at.% La and 980°C. Crystal data for all the phases are given, and the behavior of La in the formation of intermetallics with Zn, Cd, and Hg is examined. (auth)

26660 PHASE EQUILIBRIA IN THE SILVER-DYSPROSIUM SYSTEM. Delfino, S.; Ferro, R.; Capelli, R.; Borsese, A. (Univ., Genoa). J. Less-Common Met.; 44: 267-271(Jan 1976).

The Ag-Dy system has been studied by differential thermal analysis, chemical analysis and metallographic and x-ray examination. The following congruently-melting phases were observed: $Ag_{51}Dy_{14}$ (mp 990 ± 10°C), Ag_2Dy (mp 980 ± 10°C), and AgDy (mp 1185 ± 10°C). The following eutectics occur: Ag-$Ag_{51}Dy_{14}$ (800 ± 5°C, 12.0 ± 0.5 at.% Dy), $Ag_{51}Dy_{14}$-Ag_2Dy (905 ± 5°C, 28.6 ± 0.5 at.% Dy), Ag_2Dy-AgDy (950 ± 10°C, 37.5 ± 0.5 at.% Dy), and AgDy-Dy (900 ± 10°C, 74.5 ± 0.5 at.% Dy). The Ag-Dy phase diagram is compared with the already known diagrams of other Ag-R.E. systems, and is briefly discussed. (auth)

26661 INFLUENCE OF SUBSTITUTIONAL PAIRS OF COBALT ATOMS ON THE MAGNETOCRYSTALLINE ANISOTROPY OF COBALT-RICH RARE-EARTH COMPOUNDS. Deportes, J.; Givord, D.; Lemaire, R.; Nagai, H.; Yang, Y. T. (CNRS, Grenoble, France). J. Less-Common Met.; 44: 273-279(Jan 1976).

The crystallographic structures of cobalt-rich rare-earth (R) compounds are determined by the ordering of substitutional pairs of Co atoms in the same hexagonal RCo_5 basic structure. However, RCo_5 compounds are metastable at room temperature and contain some disordered substitutions. These substitutions induce a large decrease of the anisotropy in $Sm_{1-s}2Co_sCo_5$ and $Y_{1-s}2Co_sCo_5$ alloys. Consequently, with each substitution there is associated a large anisotropy with a negative value of K_1. A comparison with the strong uniaxial anisotropy of the RCo_5 basic structure is the basis of explanation of the changes of the direction of easy magnetization in $Y2(Co_{1-x}M_x)$ alloys, and the differences in the coercivity of RCo_5 compounds. (auth)

26662 NIOBIUM-ALUMINUM-GALLIUM SYSTEM. I. Phase Equilibria at 1000°C. Drys, M. (Inst. for Low Temperature and Structure Research, Wroclaw). J. Less-Common Met.; 44: 229-233(Jan 1976).

The phase relationships in the 1000°C isothermal section of the Nb-Al-Ga system have been established using an x-ray method. No ternary compounds were found. The composition ranges of stability, of A-15 and other phases formed by niobium in the ternary system, have been determined. (auth)

26663 NIOBIUM-ALUMINUM-GALLIUM SYSTEM. II. Superconducting Transition Temperatures. Drys, M.; Iliew, N. (Inst. for Low Temperature and Structure Research, Wroclaw). J. Less-Common Met.; 44: 235-238(Jan 1976).

Superconducting temperatures in the Nb-Al-Ga system are presented as a function of nominal composition. The highest, $T_c = 19.0$°K, is observed for the two-phase alloy $Nb_3Al_{0.7}Ga_{0.3}$, consisting of A-15 and σ phases. (auth)

26664 TWO CORRELATION-MODEL FOR CONDENSED SPHERICAL PACKING IN $T^{3\ldots6}$-$B^{0\ldots4}$ COMPOSITIONS. Schubert, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Less-Common Met.; 44: 23-38(Jan 1976). (In German)

A model is given for the binding in certain phases which are homotypic to close-packings. The structure of VNi_3 shows that the core electrons of the minor component tend to contract the structure while the valence electrons tend to dilate it. Good commensurability of both electron spatial correlations gives energetically low structures; this is particularly favorable at a valence electron concentration of 1.5, where the factorial commensurability of the lattice matrices of the correlations are connected by the factor 2. Factorial commensurability may be conserved while changing the composition if the structures are related by abnormal shears. When the valence electron concentration increases over 1.5 a straining stress arises perpendicular to a close-packed plane. The stress, depending on its strength, may cause a change of sub-structure stacking sequence, a change of support number of the plane, and finally a loss of translation symmetry of the close-packed planes. By these mechanisms several structures may be interpreted energetically which at present are not interpreted by any other model. (auth)

26665 STRUCTURAL AND LOW-TEMPERATURE MAGNETIC STUDIES ON COMPOUNDS Sm_2Fe_{17} WITH ALUMINIUM SUBSTITUTION FOR IRON. McNeely, D. (Oregon Graduate Center, Beaverton); Oesterreicher, H. J. Less-Common Met.; 44: 183-193(Jan 1976).

Aluminium substitution for iron in Sm_2Fe_{17} results in stabilization of the Th_2Zn_{17} structure. Compounds are homogeneous from $x = 0.20$ to $x = 0.50$ in $Sm_{0.105}Fe_{0.895-x}Al_x$ when annealed at 800°C. In this structure, Fe and Al are statistically distributed on 6(c), 9(d), 18(f) and 18(h) sites. Materials with $x = 0-0.15$ are composed of the Th_2Zn_{17} type and Fe. The magnetic hardness at cryogenic temperatures increases rapidly around a composition with $x = 0.30$. A value of coercive force, $H_c = 15$ kOe, is obtained both on bulk and powder material with $x = 0.50$ at 4.2°K. This low-

temperature magnetic hardness appears to be connected with the presence of highly energetic domain walls. The mechanism of demagnetization involves domain nucleation, in contrast with $Sm_{0.167}Co_{0.833-x}Al_x$ where demagnetization is predominantly governed by domain wall pinning. (auth)

26666 NEW f.c.c. PHASE IN YTTRIUM FILMS. Kaul, V. K.; Srivastava, O. N. (Banaras Hindu Univ., Varanasi, India). J. Less-Common Met.; 44: 137-140(Jan 1976).

A new polymorphic phase, characterized by a face-centered cubic structure, with lattice parameter 5.83 ± 0.02 Å, has been identified in thin films of yttrium. Electron diffraction evidence and electrical resistivity measurements have been carried out in order to detect the new fcc phase. (auth)

26667 INTERPRETATION OF MOESSBAUER-EFFECT AND DIFFRACTION MEASUREMENTS ON RARE EARTH–IRON COMPOUNDS OF THE TYPE R_2Fe_{17}. Elemans, J. B. A. A. (Reactor Centrum Nederland, Petten); Gubbens, P. C. M.; Buschow, K. H. J. J. Less-Common Met.; 44: 51-62(Jan 1976).

Moessbauer experiments on rare earth–iron compounds of the type R_2Fe_{17} and hexagonal symmetry can be interpreted in terms of a varying, non-stoichiometric concentration of substituted Fe pairs. Support for this is found in the existing literature of diffraction experiments on R_2Fe_{17} and R_2Ni_{17} compounds. Results of a metallographic examination are presented which show that R_2Fe_{17} compounds do not deviate, however, from the stoichiometric composition, and that some R_2Ni_{17} compounds are even Ni-deficient. A new interpretation of diffraction data is proposed that maintains the R_2M_{17} stoichiometry. (auth)

26668 IMPACT TOUGHNESS OF WELDED JOINTS OF NIOBIUM ALLOYS. Asnis, E. A.; Gurevich, S. M.; Demchenko, A. D.; Nerodenko, M. M.; Rabkina, M. D. (Inst. of Electric Welding, Kiev). Strength Mater. (USSR) (Engl. Transl.); 7: No. 1, 97-99(Jan 1975).

Translated from Probl. Prochnosti; 7: No. 1, 97-99(Jan 1975).

The effects of welding and heat treatments on the impact toughness of joints in Nb alloys were investigated. It was found that the impact toughness of welded joints of niobium alloys varies with the welding speed. The impact toughness reaches the highest values at welding speeds of 40 to 60 m/h and then remains constant. The impact toughness changes least for niobium alloys with solid solution hardening. Separation of the impact toughness into its component parts showed that higher welding speeds are preferable. The optimum conditions for heat treating weld seams in Nb–Zr and Nb–W alloys are 1200 and 1200 to 1300°C respectively with holding for 1 h. (auth)

26669 MECHANICAL PROPERTIES OF MOLYBDENUM BICRYSTALS. Yastrebkov, A. A.; Lakeenkov, V. M. Strength Mater. (USSR) (Engl. Transl.); 7: No. 1, 75-79(Jan 1975).

Translated from Probl. Prochnosti; 7: No. 1, 75-80(Jan 1975).

The effects of crystal boundary disorientation and differing crystallographic planes on the strength and ductility of Mo were investigated. Precipitates found at the grain boundary surface are probably not responsible for the intercrystalline failure which occurs. Weakening of the boundary may be due to the segregation of interstitial impurities at the boundary. (JRD)

26670 CHARACTERISTICS OF DANGEROUSLY INFLAMMABLE AND EXPLOSIVE ZIRCONIUM POWDERS PREPARED BY REDUCTION WITH CALCIUM AND SODIUM. Olishevets, V. A.; Selivanova, V. M.; Nevgod, V. A. pp 127-131 of Preduprezhdenie Vnezapnykh Vosplamenenii Poroshkov I Vzryvov Gazodispersnykh Sistem. Nedin, V. V. (ed.). Kiev; Izdatel' stvo Naukova Dumka (1975). (In Russian)

Experimental results from a study of the characteristics of dangerously inflammable or explosive Zr powders were reported. It was established that powders with a diameter of 50 μ are both inflammable and explosive. Their activity is explained by the high content of active Zr and the development of a specific surface. Methods were proposed for the determination of the minimum oxygen concentration that would permit combustion in protective media for powder films. (tr-auth)

26671 IGNITION OF TITANIUM AND ZIRCONIUM POWDERS FROM A FRICTION SPARK. Olishevets, V. A.; Selivanova, V. M.; Nevgod, V. A. pp 132-136 of Preduprezhdenie Vnezapnykh Vosplamenenii Poroshkov I Vzryvov Gazodispersnykh Sistem. Nedin, V. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

Experimental results are reported on studies of the combustibility of industrial Ti and Zr powders in layers during contact with a friction spark. It was shown that the combustibility of the powders depends on their activity, form of the sparking material, thickness of the layer, thermophysical properties of the substrate materials, and to some degree on the duration of the spark. (tr-auth)

26672 NH_3 GROUP AND $[Cd(NH_3)_6]^{2+}$ ION DYNAMICS IN CADMIUM HEXA-AMINO–FLUOROBORATE $[Cd(NH_3)_6](BF_4)_2$. Pislewski, N.; Stankowski, J.; Larys, L. (Inst. of Molecular Physics, Poznan, Poland). Phys. Status Solidi (a); 31: No. 2, 415-418(16 Oct 1975).

Relaxation times T_1 and $T_{1\rho}$ versus temperature in cadmium hexa-aminofluoroborate are measured and used to determine the activation energy of tumbling motion for the complex cation as E_a = 6.6 kcal/mol; from T_1-studies at low temperatures, an energy of E_a = 2 kcal/mol is found for the hindered rotation activation of the NH_3 groups. The discontinuity of T_1 at T_c = 147 K permits to define the latter temperature as that of phase transition.

26673 COBALT MOMENT IN $Ho_xY_{1-x}Co_2$ AND $Ho_xY_{1-x}(Fe_{0.1}Co_{0.9})_2$. Steiner, W.; Ortbauer, H. (Technische Hochschule, Vienna). Phys. Status Solidi (a); 31: No. 2, K119-K123(16 Oct 1975).

The effect of increased Ho concentration and the addition of Fe on the moment of the 4f electrons in Co was studied. The variations of the field strength dependence of the magnetization, the temperature dependence of the magnetization, and the concentration dependence of the saturation magnetization were determined for various concentrations of Ho and Fe additions; the results are shown graphically. (JSR)

26674 SUPERCONDUCTING AND MAGNETIC PROPERTIES OF $ZrV_{2-x}Fe_x$ AND $HfV_{2-x}Fe_x$ ALLOYS. Duffer, P. (Univ. of Pittsburgh); Sankar, S. G.; Rao, V. U. S.; Bergner, R. L.; Obermyer, R. Phys. Status Solidi (a); 31: No. 2, 655-660(16 Oct 1975).

The superconducting, magnetic and structural properties of the ternary alloys $ZrV_{2-x}Fe_x$ and $HfV_{2-x}Fe_x$ (x = 0 to 2) have been investigated. The superconducting transition temperature T_c and the upper critical field H_{c2} are determined from resistivity measurements. The Curie temperatures T_M of the Fe-rich compositions are determined. The crystal structures of the terminal phases (x = 0 and x = 2) are of the cubic Laves type (C15) while many of the intermediate compositions have the hexagonal Laves structure (C14 type). The lattice parameters of the various compositions are reported. For dilute Fe impurities in HfV_2 and ZrV_2, H_{c2} is enhanced over that of the parent compounds. These results are interpreted as arising from a negative exchange coupling between the Fe and the conduction electron spins. (auth)

26675 NEW TYPE OF ELECTRICAL INSTABILITY IN CdS. Gilbert, F.; Hoffmann, H. J. (Univ., Karlsruhe, Ger.). Phys. Status Solidi (a); 31: No. 2, 543-546(16 Oct 1975).

A new type of current oscillations in the range of 10^{-3} to 10 Hz has been observed in illuminated CdS single crystals with electron concentrations in the order of 10^7 to 10^{10} cm^{-3}. These instabilities have been observed at field strengths as low as 5×10^2 V cm^{-1} with and without additional quenching light. Furthermore, there is no region of negative differential conductivity in the I–U-characteristic. (auth)

26676 MOLAR HEAT CAPACITY OF SUPERCONDUCTING PdH_x AT LOW TEMPERATURES. Zimmermann, M.; Wolf, G.; Bohmhammel, K. (Sektion Chemie der Bergakademie, Freiberg i. B.). Phys. Status Solidi (a); 31: No. 2, 511-517(16 Oct 1975).

The molar heat capacity of superconducting PdH_x ($2.4°K \leq T_c \leq 7.4°K$) was measured in the temperature range from 2 to 12°K. The γ-coefficients and Debye temperatures of samples with different atomic ratios $x = H/Pd$ ($0.78 \leq x \leq 0.96$) were determined. In dependence on T_c a remarkable change of the Debye temperature was observed. Therefore, from the calorimetric results it seems probable that the increase of T_c with increasing x-value is a consequence of the lattice extension. Such an assumption seems also valid for the explanation of the isotope effect and the pressure effect. (auth)

26677 MOESSBAUER EFFECT INVESTIGATION OF $ErFe_3$ AND YFe_3. van der Kraan, A. M. (Interuniversitair Reactor Inst., Delft, Netherlands); Gubbens, P. C. M.; Buschow, K. H. J. Phys. Status Solidi (a); 31: No. 2, 495-501(16 Oct 1975).

The easy direction of magnetization in $ErFe_3$ and YFe_3 has been investigated as a function of temperature. In $ErFe_3$ a magnetic phase transition is observed at T = 50°K. At T < 50°K the magnetization is pointing along the crystallographic c-axis, while at T > 50°K the magnetization is parallel to the b-axis. For YFe_3 the magnetization is found to be parallel to the b-axis in the temperature region from T = 4.2°K up to the Curie temperature at 538°K. (auth)

26678 COERCIVE FORCE AND CRYSTAL STRUCTURE OF RT_5 SINGLE CRYSTALS. Deryagin, A. V.; Barabanova, E. A.; Ulyanov, A. I. (Ural State Univ., Sverdlovsk, USSR). Phys. Status Solidi (a); 31: No. 2, 391-397(16 Oct 1975).

The influence of heat treatment on coercive force H_{ci} and crystal structure of $SmCo_{5+x}$ single crystals is studied. The non-monoto-

nous $H_{0i}(T)$ dependence is explained from the point of view of phase transformation occurring during heat treatment and caused by the existence of a homogeneity region in the compound $SmCo_5$. Perspectives of obtaining single crystal permanent magnets with energy product values up to 4×10^7 GOe on the base of RT_5 compounds (R = Sm, Pr; T = Co, Fe) are discussed. (auth)

26679 AGING OF CONDENSED FILMS OF Cu–Be. Beleicheva, T. G.; Ailing, K. K.; Soldatenkov, I. S. (Inst. of Semiconductor Physics, Moscow). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 136-139(1975). (In Russian).

The singularities in the aging of condensed films of Cu–Be were studied in the temperature interval from 25 to 500°C by x-ray structural analysis and by measurement of the mechanical properties. The results showed that the aging of films differs from that of massive samples. The decomposition of the supersaturated α solid solution in the films proceeds with the precipitation of the equilibrium γ phase. The appearance of this phase was fixed even after a two-hour annealing at 200°C. A comparison of the results obtained with literature data indicates that the decomposition processes are similar to those occurring at the grain boundary but different from those occurring within the crystal. (JSR)

26680 NEUTRON SCATTERING ON VIBRATIONS OF CRYSTALS HAVING A FINITE CONCENTRATION OF SUBSTITUTED ATOMS. Murtazin, I. A. (Udmursk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 112-118(1975). (In Russian).

The scattering of neutrons by the oscillation of lattices containing a finite concentration of substituted atoms is analyzed mathematically. The results show that if the scattering amplitude of the foreign nucleus varies only slightly from the scattering amplitude of the matrix nuclei, then the contribution, linear with respect to the concentration, from the scattering on implanted nuclei can be much larger than the contribution from the same nuclei but occurring only in the lattice points. (JSR)

26681 THE EFFECT OF OXYGEN-DOPING ON THE ELECTRICAL RESISTIVITY OF VANADIUM. Lang, E.; Bressers, J. (Commission of the European Communities, Petten (Netherlands). Materials Dept.). Z. Metallkd.; 66: No. 10, 619-622(Oct 1975).

3 figs.; 3 tabs.; 20 refs.

High-purity vanadium single crystals characterized by resistance ratios in the range of 1,100 were doped to different oxygen levels and their electrical resistivity increase was measured as a function of the oxygen concentration. In the temperature range investigated, 77 to 293°K, the Matthiessen rule is obeyed. The increase in electrical resistivity per atomic percent oxygen is shown to be 5.16 $\mu\Omega$cm. For the ideal resistivity ratio ρ_i (77 K)/ρ_i (293 K) a value of 0.116 could be determined. (DE)

26682 FIELD IONIZATION OF METHANE AND HYDROGEN AT TUNGSTEN MONOCRYSTAL AREAS. Baetjer, K. Berlin; Freie Univ., Berlin (1972). 93p. (In German). INIS.

Thesis.

A recipient of special steel was constructed and then incorporated in an ultra-high vacuum system suitable for FEE, FEM, FI, and FIM investigations on the surfaces of metal single crystals. With the applied "probe hole" technique, small surface regions can be projected on a continuous multiplier, a channeltron, by means of a fluorescent screen. Using a multichannel analyzer, the channeltron can measure extremely small particle rates. Calibration measurements of electrons, protons, hydrogen ions, and methane ions were carried out at the channeltron using a Faraday target. The time-dependent FEE investigations suggest a field-dependent surface diffusion assumed to be hydrogen, which is dependent on the strength of the applied field. (DE)

26683 EVIDENCE FOR SPECULAR REFLECTION IN THIN TUNGSTEN WIRES. Stone, E. L. III; Khoshnevisan, M.; Bass, J. (Michigan State Univ., East Lansing (USA). Dept. of Physics). Phys. Kondens, Mater.; 19: No. 1-4, 383-388(1975).

1 fig.; 11 refs.

A generalized version of the Nordheim model, appropriate to a metal with an anisotropic electron mean-free-path, is used to derive a lower bound upon the resistivity of a wire of diameter d when scattering from the wire surface is completely diffuse. Measurements of the electrical resistivities of thin tungsten wires are presented and shown to fall below this lower bound. These measurements are, therefore, inconsistent with the existence of completely diffuse surface scattering. Within the framework of the model, the data determine an amount of specular scattering specified by a specularity parameter of magnitude $p \geq 0.2$. (DE)

26684 MAGNETOELASTIC INTERACTION RARE EARTH SYSTEMS. Dohm, V. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (F. R. Germany); Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung); Fulde, P. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (F. R. Germany)). Z. Phys., B; 21: No. 4, 369-379(Aug 1975).

3 figs.; 24 refs.

A theory of rotationally invariant spin-lattice interactions in rare earth systems is presented. It is shown that rotational invariance to leading order is ensured only if rotational interactions of first and second order in the displacements are included simultaneously in the spin-lattice Hamiltonian. The rotational second-order interactions yield effects which are as large as those of the linear rotational interaction. It is pointed out that a corresponding statement should hold also for pure strain interactions. The phonon Green's function is calculated for the paramagnetic phase of rare earth systems. It is found that in an applied magnetic field the rotational interactions cause measurable changes of the phonon dispersion and the sound velocity even for cubic symmetry. These effects turn out to be of the same order of magnitude as the conventional field-dependent strain effects and are qualitatively different from the latter. The results of our theory are illustrated by the example of SmSb, and quantitative predictions for the transverse sound velocities are given. (DE)

26685 LOW FIELD HALL-EFFECT OF POLY-VALENT METALS IN THE NEARLY FREE ELECTRON APPROXIMATION. Pt. 1. Al, In, and Pb. Bergmann, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Z. Phys., B; 21: No. 4, 347-355(Aug 1975).

3 figs.; 5 tabs.; 25 refs.

The formula by Tsuji for the low field Hall-coefficient is applied for tri- and tetra-valent metals in the fcc structure. Under the assumption of sufficient small pseudo-potential the evaluation of the Tsuji formula is rather simple. The Fermi-surface can be divided into different parts: the free electron sphere and the ring-shaped distorted parts at the intersection circles with the Bragg-planes. The latter represent electron-like and hole-like carriers: the Bragg-particles. The actual Hall coefficient is a sum of the free electron Hall-coefficient R_0 and the contribution of the Bragg-particles. The latter is of the same order of magnitude as R_0. Its sign depends on the actual scattering potential and on the sign of the pseudopotential. A successful comparison with experimental results for Al, In and Pb is given for impurity scattering, thermal scattering, and temperature dependence. A measurement of the Hall-effect under pressure is suggested to prove the dominant role of the sign of the pseudopotential for the Hall-effect. (DE)

26686 X-RAY AND NMR [NUCLEAR MAGNETIC RESONANCE] INVESTIGATIONS OF COBALT. Creagh, D. C.; Bailey, S. G.; Wilson, G. V. H. Philos. Mag.; 32: No. 2, 405-415(Aug 1975).

X-ray diffraction and zero-field NMR spectra were studied for powdered and bulk polycrystalline and single-crystal specimens of Co. The nature of the hcp → fcc phase transformation was studied. The two stacking-fault NMR lines are both due to deformation faults in hcp regions.

26687 ENERGY LOST BY FAST HELIUM AND NITROGEN IONS PASSING THROUGH METAL FILMS [IN RELATION TO FILM STRUCTURE]. Bednyakov, A. A.; Bulgakov, Yu. V.; Nikolaev, V. S.; Sobakin, V. P.; Popov, B. M. Zh. Eksp. Teor. Fiz.; 68: No. 6, 2067-2074(Jun 1975). (In Russian)

The energy lost by 330-keV He and N ions in passing through Al, Cu, Ag, and Au films of various thicknesses was analyzed statistically (the width of the energy-distribution curves of the transmitted particles being determined) and the results were correlated with the interior and surface structure of the films, e.g., the degree of surface roughness. The thickest targets absorbed 80% of the original energy. On plotting the width of the distributions against total loss (relative to the original energy) curves with flat maximum at a loss of approximately half the original energy were obtained in each case, the exact position of the maximum depending on the particular metal. Theory agreed qualitatively but not quantitatively with experiment.

26688 NEUTRON SCATTERING AND MAGNETIZATION MEASUREMENTS ON THE KONDO COMPOUND $CeAl_3$. Edelstein, A. S.; Brun, T. O.; Lander, G. H.; McMasters, O. D.; Gschneider, K. A. Jr. pp 428-429 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Previous measurements on the Kondo compounds, $CdAl_3$ (hexagonal DO_{19}), indicate that with decreasing temperature it transforms gradually into a singlet state and does not magnetically order greater than 0.6°K. To determine the spatial extent of the magnetic moment the spin-dependent cross-section of neutrons diffracted from the (201) planes of a polycrystalline sample in 50 kOe at 5, 19, and 81°K was measured. At 50 kOe and these temperatures the total moment from magnetization measurements

on the same sample is only 5 to 15 percent lower than the moment determined by the neutrons if a 4f form factor is assumed. This approximate agreement supports the hypothesis that the moment decreases without changing its spatial distribution. A similar spatially uniform reduction of the moment occurs also in dilute Kondo systems. From the field dependence of the magnetization M, the characteristic or Kondo temperature is estimated to be 5.1°K. (Metals Abstr.)

26689 MAGNETIC AND LATTICE PROPERTIES OF CeBi. Lander, G. H.; Mueller, M. H.; Vogt, O. pp 430-431 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The magnetic structures of CeBi have been examined as a function of field with neutron diffraction. At low fields unusual domain reorientation effects are observed. For H greater than 18 kOe a 3+, 1-spin configuration is found. A first-order transition to induced ferromagnetic behavior occurs at 47.5 kOe. X-ray experiments at low temperature show that no lattice distortion occurs at either T/sub N/ equals 25°K or the I-IA transition at 12.5°K. A volume discontinuity is observed at the low-temperature transition. (Metals Abstr.)

26690 FERROMAGNETIC RESONANCE RELAXATION PROCESSES IN Zn_2Yt. Mita, M.; Shimizu, H. pp 514-515 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Experimentally obtained linewidth in FMR of Zn_2Y is analyzed numerically on the basis of two-magnon, three-magnon and four-magnon relaxation processes. In the analysis procedure of three-magnon linewidth, the effective exchange constants are determined to be D equals 0.15×10^{-9} Oe cm^2 and D equals 9.3×10^{-9} Oe cm^2 within and between the crystallographic planes. The two-magnon linewidth induced by surface imperfections is discussed in consideration of scattering due to multipole demagnetizations of the imperfections. The four-magnon linewidth is observed for the first time and analyzed successfully. (Metals Abstr.)

26691 POLAR KERR ROTATION AND SUBLATTICE MAGNETIZATION OF GdCoMo BUBBLE FILMS. Argyle, B. E.; Gambino, R. J.; Ahn, K. Y. pp 564-566 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Kerr rotation in Gd–Co–Mo alloys is due mostly to the Co atoms. Polar Kerr loops vs composition and temperature were investigated, and total magnetization (from initial loop susceptibility and domain size) and the Co sublattice magnetization (from the saturated Kerr rotation angle) determined. Deviations from the characteristic Kooy and Enz loop behavior due to thin approximately 100 A surface layer anomalies are first identified and removed to analyze the bulk film behavior. (Metals Abstr.)

26692 UNIAXIAL ANISOTROPY IN RARE EARTH (Gd,Ho,Tb)–TRANSITION METAL (Fe,Co) AMORPHOUS FILMS. Heiman, N.; Onton, A.; Kyser, D. F.; Lee, K.; Guarnieri, C. R. pp 573-574 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Evidence is presented that magnetic uniaxial anisotropy in amorphous RE/TM films is a more common feature than had been presumed. The incident atomic beam direction appears to define the anisotropy axis in thermally evaporated films while the electric field direction at the surface is the dominant influence in bias sputter deposition. The nature of the coupling is also found to vary. (Metals Abstr.)

26693 REVERSAL OF HALL EFFECT AND KERR ROTATION IN FERRIMAGNETIC RARE EARTH–COBALT SYSTEMS. Ogawa, A.; Katayama, T.; Hirano, M.; Tsushima, T. pp 575-576 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Hall effect in the ferrimagnetic systems of rare earth (R) and Co, such as Gd_3Co_7, and its temperature dependence, especially near compensation temperature, is investigated both theoretically and experimentally. The polarity of the Hall voltage in these materials is reversed at the compensation temperature, and it is similar to the reversal in optical Kerr effect. The anomalous part of the Hall voltage is separated theoretically into two independent parts; one is of R and the other of Co. The contribution of R to the observed Hall voltage is considered to be several hundred times larger than that of Co in the ferrimagnetic temperature region by taking the large spin/orbit interaction of R into account, and the reversal of the Hall voltage at the temperature is explained essentially in terms of the anomalous Hall effect originated dominantly from R. On the other hand, the variation of Kerr rotation with temperature comes mainly from Co in the visible region. (Metals Abstr.)

26694 MOESSBAUER AND X-RAY STUDY OF THE SELF-INDUCED MAGNETOSTATIC DISTORTION OF Tb/sub x/Yt/sub 1-x/Fe_2 LAVES PHASES. Preston, R. S.; Dwight, A. E.; Fedro, A. J.; Kimball, C. W. pp 660-661 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

A comparison has been made between x-ray diffraction data and Moessbauer absorption data for a series of ferrimagnetic compounds Tb/sub x/Y/sub 1-x/Fe_2. Previous work has shown that the volume and the rhombohedral angle of the distorted "cubic" unit cell both vary with the Tb concentration x, but that the distortion disappears for x less than or equal to 0.25. A detailed study was made of the ^{57}Fe Moessbauer spectra for these compounds in the vicinity of x equals 0.25. Results confirm the previous finding that the magnetic hyperfine field varies continuously with the Tb concentration. Also, they reveal that the Fe sites are not all equivalent chemically and crystallographically, and that this is true whether or not the rhombohedral distortion is present. This suggests that in addition to the rhombohedral distortion there may be an independent distortion or shifting of the Fe tetrahedra within the unit cube. (Metals Abstr.)

26695 SPIN REORIENTATION STUDIES IN CUBIC LAVES RARE-EARTH IRON COMPOUNDS. Atzmony, U.; Dariel, M. P. pp 662-663 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Several types of spin reorientation occur in Ho/sub x/Er/sub 1-x/Fe_2, particularly that from the [110] towards the [100] direction. In all cases the general behavior of the hyperfine fields at the inequivalent Fe sites is well accounted for by magnetic dipolar contributions. Analysis of the Moessbauer spectra taken in the spin rotation temperature interval indicates that the easy axis of magnetization deviates from the axes of symmetry of the cubic system. In the [110] to [111] rotation the spin is in the (1 anti 10) plane, while in the [110] to [100] transition it rotates continuously within the (001) plane. (Metals Abstr.)

26696 STRESS DEPENDENCE OF THE MAGNETIC SUSCEPTIBILITY IN PRASEODYMIUM BETWEEN 1.5 AND 25°K. Ott, H. R. pp 664-665 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The magnetostriction parallel and perpendicular to the hexagonal axis of single-crystal Pr has been measured in magnetic fields up to 10 kOe. From these measurements the stress dependence of chi/sub parallel/ and chi/sub perpendicular/ has been determined. The data can be used to calculate the influence of changes of the axial ratio c/a on chi/sub parallel/ and to estimate the same property of chi/sub perpendicular/. From these results it is concluded that the anisotropy of chi below 30°K can be explained only partly by the strong variation of rho (rho c/a) below that temperature, and the increase of chi/sub parallel//chi/sub perpendicular/ with decreasing temperature is mainly due to crystal field effects, as suggested by Rainford. It also seems very unlikely that the observed ordering effects in polycrystalline Pr are due to strain effects in these samples. (Metals Abstr.)

26697 MAGNETIC-ANNEAL-INDUCED UNIAXIAL ANISOTROPY IN $TbFe_2$. Schelleng, J. H.; Koon, N. C. pp 668-669 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Low temperature magnetic measurements were made on polycrystalline samples of $TbFe_2$. Hysteresis curves taken after the

material was cooled to temperature below 80°K in the presence of a field were found to be oddly distorted when the measuring field direction and the annealing field direction differed. This behavior can qualitatively be explained in terms of a model based on the high cubic anisotropy and magnetostriction existing in this material, plus an added, anneal-induced uniaxial anisotropy. Activation energy studies at the annealing temperature indicate that dislocations are involved in the annealing process. (Metals Abstr.)

26698 MAGNETOSTRICTION OF SINGLE CRYSTAL AND POLYCRYSTAL RARE EARTH-Fe_2 COMPOUNDS. Clark, A. E.; Cullen, J. R.; Sato, K. pp 670-671 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Magnetostriction measurements on single-crystal and polycrystal $TbFe_2$ and $ErFe_2$ are reported and compared. For $TbFe_2$ the largest known room temperature magnetostriction constant was found: $lambda_{111}$ equals 2400 x 10^{-6}. For $ErFe_2$: $lambda_{111}$ equals -300 x 10^{-6}; $lambda_{111}$ is the dominant magnetostriction constant and the major source of the magnetostriction of the polycrystalline rare earth–Fe_2 alloys. $TbFe_2$ possesses the largest known cubic anisotropy constant. At room temperature K_1 equals -7.6 x 10^7 erg/cm^3. The sign of the anisotropy plays an important role in determining the field dependence of the polycrystalline magnetostriction. (Metals Abstr.)

26699 MAGNETIZATION AND MAGNETIC ANISOTROPY IN Lu/sub x/Tm/sub 2-x/Co_{17} INTERMETALLICS. Miller, A. E.; Miura,.K.; Rodrigues, H.; D'Silva, T. pp 672-673 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The temperature and field dependence of the magnetization of the hexagonal intermetallic compounds, Lu/sub x/Tm/sub 2-x/Co_{17} (x equals 0, $^2/_3$, $^4/_3$, 2) has been determined as a function of crystallographic direction. All specimens were single-crystal spheres and measurements were made in the temperature range 77.4 to 450°K in applied fields up to 13 kOe. The anisotropy constants K_1 and K_2 were determined and the anisotropy behavior was found to obey the single ion model. (Metals Abstr.)

26700 PROPERTIES OF MICROSAMPLES OF SINTERED COBALT–SAMARIUM MAGNETS. Becker, J. J. pp 676-677 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Hysteresis loops of small but still multi-grain samples taken from sintered Co_5Sm magnets show a wide range of behavior, samples from the same magnet bracketing the bulk properties. Magnetization discontinuities often appear and are associated with large grains. These jumps show a quantized dependence of jump field on magnetizing field and often a good 1/cos theta dependence, exactly as in particles prepared from cast material. A sample consisting of only one grain gave a completely rectangular loop. Measurements on sintered magnets indicated that large grains tend to reverse in small fields, detracting from the over-all properties. (Metals Abstr.)

26701 LOW TEMPERATURE MAGNETIC HARDNESS IN SUBSTITUTED $SmCo_5$. Oesterreicher, H.; McNeely, D. pp 678-679 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The mechanism of magnetization at liquid He temperature is investigated in alloys based on $SmCo_5$ with partial substitution for Co by Ni, Ag, Al, and Si. Further materials $Y_{0.167}Co_{0.683}Al_{0.15}$ and $Gd_{0.167}Co_{0.683}Al_{0.15}$ are included. Aluminum and Si substituted materials when obtained by quenching from the melt exhibit stacking fault structures in the basal plane. These materials show, at 4.2°K, outstanding coercive forces in bulk and powder form (with extrapolated values of approximately 60 kOe at the phase boundary $Sm_{0.167}Co_{0.408}Al_{0.225}$). When bulk alloys are annealed (700°C) demagnetization takes place spontaneously at critical fields with a slope comparable to the demagnetization factor rather than with the considerably smaller slope found in materials prepared by quenching from the melt. Nickel and Ag substituted $SmCo_5$, as well as $Y_{0.167}Co_{0.683}Al_{0.15}$ and $Gd_{0.167}Co_{0.683}Al_{0.15}$ show no appreciable coercive forces at 4.2°K. Results are discussed in terms of a model of homogeneous pinning of domain walls of atomic dimensions on the crystal lattice. The role of substituent and rare earth in establishing highly energetic domain walls is discussed. (Metals Abstr.)

26702 EVIDENCE FOR NEW MAGNETIC RARE EARTH–COBALT PHASES. Strnat, K. J.; Ray, A. E. pp 680-682 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

An infinite series of hypothetical intermetallic compounds, with compositions converging toward RCo_5, can be derived by c-axis stacking of RCo_5 cells and selective substitution of R atoms for Co: RCo_2, RCo_3, R_2Co_7, R_5Co_{19}, RCo_4, R_7Co_{29}, R_4Co_{17}, R_3Co_{13}, R_5Co_{22}. The first three compound types are well known. R_5Co_{19} phases were recently found for R equals La, Ce, Pr, and Nd. Dynamic permeability vs temperature measurements (-190 to +700°C) on several RCo/sub x/ alloys with R equals La, Ce, Pr, Nd, and Sm in the range 3.5 less than x less than 5 yielded Curie points for the R_5Co_{19} and indicated the existence of several more phases. From the observed distinct permeability peaks Curie temperature are determined and compared with expected values based on the compositions of the above phases. No discrete peaks were observed for Sm–Co but a broad maximum between the Curie temperature of Sm_2Co_7 and $SmCo_5$ indicates that certain heat treatments produce intermediate, disordered structures. (Metals Abstr.)

26703 PHASE TRANSFORMATIONS IN THE ALLOY HASTELLOY B. Ruedl, E. (EURATOM, Ispra, Italy). Mater. Res. Bull.; 10: No. 12, 1267-1272(Dec 1975).

The alloy Hastelloy B undergoes phase transformations in the temperature range of approximately 600 to 800°C. These phase transformations were studied in some detail by electron microscopy. The essential result of this study was the observed formation of the DO_{22} structure as an intermediate phase. The DO_{22} structure is relatively stable in Hastelloy B and its further transformations are easily observable. At 600°C it is transformed to Ni_4Mo followed by a partial transformation to Ni_3Mo, whereas at 700°C Ni_3Mo is formed from DO_{22} directly. (auth)

26704 INFLUENCE OF THE STRUCTURE ON THE MECHANICAL PROPERTIES OF URANIUM-MOLYBDENUM ALLOYS WITH HIGH MOLYBDENUM CONTENTS. Nomine, A. M.; Miannay, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). Mem. Sci. Rev. Metall.; 72: No. 3, 255-276 (Mar 1975). (In French)

From autumn meeting on metallurgy; Paris, France (1 Oct 1973).

The tensile properties and the fracture toughness of several U-Mo alloys (molybdenum content between 8 and 12 wt.%) are studied at room temperature for different structures (rough-cast, homogenized, rolled). The alloy with 10% Mo content shows the best properties on average. (FR)

26705 OPTICAL ABSORPTION IN THE SYSTEM OF CHROMIUM–VANADIUM. Kirillova, M. M.; Nomerovannaya, L. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 39: No. 3, 303-305(Sep 1975).

Translated from Opt. Spektrosk.; 39: No. 3, 540-545(Sep 1975).

Measurements of the refractive index n and the absorption coefficient k of pure chromium and chromium–vanadium alloys (2, 20, 30, 50, 70 wt % vanadium) are performed in the spectral range of 0.3–17 μm $\hbar\omega$ = 4.1–0.068 eV) at 295°K. The character of the change of the light conductivity $\sigma(\omega)$ and of the real $\epsilon_1(\omega)$ and imaginary parts $\epsilon_2(\omega)$ of the dielectric constant in the alloys is analyzed. In an energy interval of $\hbar\omega$ = 0.3–0.9 eV, a fine structure of the optical absorption of pure chromium, associated with interband electron transitions, is observed. The plasma frequency Ω and the relaxation frequency γ of the conduction electrons are determined for all compositions from the ir measurements. (auth)

26706 DEPENDENCE OF THE SURFACE TENSION OF METALS AT THEIR MELTING POINT ON THE MAGNITUDE OF THE SUPERCOOLING. Dzhuraev, T. D.; Vakhobov, A. B.; Eshonov, K. K. (Inst. of Chemistry, Dushambe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 18: No. 6, 36-39(1975). (In Russian)

A correlation dependence of the surface tension for the crystal–melt and crystal–vacuum interfaces at their melting points on their maximum supercooling was established. Literature and theoretical data are tabulated on the supercooling and the surface tension at the crystal–melt and crystal–vacuum interfaces. (JSR)

26707 QUANTITATIVE NEUTRON RADIOGRAPHY. Mars, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plu-

tonium). pp 30-33 of Neutron Radiography. Paris; Kodak-Pathe (1974). (In French)

Neutron radiography allows a quantitative inspection titration in the case of the PtIr20 alloy used for the outside can of the energy source of the ^{238}Pu cardiac pacemaker. (FR)

26708 NATURE OF THE INITIAL STRAIN-HARDENING STAGE IN BERYLLIUM. Khristenko, I. N.; Papirov, I. I. (Inst. of Physics and Tech., Kharkov). Strength Mater. (USSR) (Engl. Transl.); 7: No. 3, 381-382(Mar 1975).

Translated from Probl. Prochnosti; 7: No. 3, 115-116(Mar 1975).

The coefficient of strain hardening is calculated. The increase of mobile dislocation density during initial stage of deformation can be judged from the relation of activating volume to deformation. Strain hardening in Be in the initial stage is linked with an increase in both the total and the mobile dislocation densities. (DLC)

26709 CYCLIC STRENGTH OF A COMPOSITE SHEET REINFORCED BY TUNGSTEN. Gaiduk, V. V.; Morozov, L. V.; Sukhanov, Yu. V. (Engineering Inst., Moscow). Strength Mater. (USSR) (Engl. Transl.); 7: No. 3, 372-375(Mar 1975).

Translated from Probl. Prochnosti; 7: No. 3, 106-109(Mar 1975).

The heat-resisting EHI 435 Nichrome alloy was used as the matrix; BA tungsten filaments 0.5 mm thick were used as reinforcement. Fatigue strength was investigated of composite sheets 1 mm thick prepared by welding followed by hot rolling. The fatigue plot of the reinforced sheet lies below that of unreinforced EHI 435, indicating that the reinforcing phase, which improves the static strength, produces considerable weakening under cyclic loads at normal temperatures. (DLC)

26710 PREPARATION AND CHARACTERIZATION OF SPLAT-COOLED R–Co COMPOUNDS. Ratnam, D. V.; Narasimhan, K. S. V. L.; Giessen, B. C. pp 687-688 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Rapidly quenched alloys of Sm–Co, Pr–Co and MM–Co of the approximate composition RCo_5 were prepared by splat cooling in a modified arc furnace. X-ray diffraction analysis indicated a fine-grained structure and the possibility of some texture in the splat-cooled samples. Microscopic examination of the alloys in a light microscope revealed an equiaxed fine-grained structure with a grain size of 2 to 5 mu m. Magnetic measurements were performed on a vibrating sample magnetometer. Coercive force values were 5000 Oe for $SmCo_5$, 1500 Oe for $PrCo_5$, and 1250 Oe for $MMCo_5$. Thermomagnetic curves were obtained on the splat-cooled alloys by plotting magnetization vs. temperature up to 900^0C. The data indicated that all the alloys were single phase with Curie points in fair agreement with published values for these compounds. Splat-cooled $PrCo_5$ was found to be unstable near its Curie temperature. (Metals Abstr.)

26711 MAGNETIC PROPERTIES OF R(Co/sub 1-y/Cu/sub y/)$_2$ COMPOUNDS. Perkins, R. S.; Perry, A. J.; Nagel, H.; Menth, A. pp 693-694 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The hard magnetic characteristics of compounds having composition Sm(Co/sub 1-y/Cu/sub y/)/sub z/ and lying within the phase space 5.0 less than or equal to z less than or equal to 8.5, 0 less than or equal to y less than or equal to 1.0, are strongly influenced by the nature of their metallurgical microstructure. However, by measurement of the anisotropy field, domain size, and angular dependence of the coercivity, and in conjunction with data obtained from transmission electron microscopy, as well as the implications of a theoretical model for the coercivity in these materials and simple arguments concerning the diluting effect of Cu upon the primary magnetic properties of the constituent phases, the principal features of this group of materials may be clarified. (Metals Abstr.)

26712 PERMANENT MAGNETS ON THE BASIS OF $MMCo_5$ AND THE RELATION BETWEEN THEIR PROPERTIES AND THE PRIMARY MAGNETIC PROPERTIES OF THESE COMPOUNDS. Nagel, H.; Klein, H. P. pp 695-696 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The permanent magnetic properties of MM/sub 1-x/Sm/sub x/Co_5 magnets, prepared by powder-metallurgical means, have been studied in the range 0 less than x less than 0.4 and for various chemical compositions of MM. For both coercivity and energy product, a nearly linear dependence on the Sm content was found in the range investigated. Moreover, there is a very strong correlation between the permanent magnetic properties and the composition of the MM. By optimizing the composition, $MM_{0.85}Sm_{0.15}Co_5$ magnets can be produced with a coercivity /sub I/H/sub c/ greater than 16 kOe and H/sub k/ greater than 14 kOe, respectively, and a maximum energy product of up to 18 MG Oe. These values are discussed with respect to the primary magnetic properties of these compounds as obtained from single-crystal measurements. (Metals Abstr.)

26713 MAGNETIC EXCITATIONS IN RARE EARTH-Al_2 COMPOUNDS. Bak, P. pp 152-158 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Recent experimental and theoretical work on rare earth-Al_2 compounds is reviewed. The excitons in $NdAl_2$ and $TbAl_2$ have been studied by inelastic neutron scattering. The dispersion relations are analyzed within the random phase approximation using a Hamiltonian including 4th- and 6th-order crystal field terms and an isotropic exchange interaction. The spectrum of $NdAl_2$ at 5^0K comprises both transverse and longitudinal modes, corresponding to transitions between the ground state and excited mean-field states. The bulk magnetic properties of $NdAl_2$ can be understood quantitatively using the crystal field parameters derived from the analysis of the exciton spectrum. At 4^0K the magnetic excitations in $TbAl_2$ are spin waves. At temperatures greater than 35^0K the neutron scattering measurements show a double-peak structure. This splitting of the spin wave branch is the result of an interaction between the spin-waves and excitations associated with higher-lying mean-field states, a magnonexciton interaction. (Metals Abstr.)

26714 HYPERFINE ENHANCED NUCLEAR COOLING TO 1.3 mK IN $PrNi_5$. Andres, K.; Schmidt, P. H.; Darack, S. pp 238-239 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Single crystals of $PrNi_5$ were grown which crystallize in the hexagonal $CaCu_5$ structure, and the well-known maximum in the susceptibility occurred only normal to the c-axis, contrary to previous theoretical crystal field predictions. Below 4.2^0K, in the Van Vleck paramagnetic regime, the hyperfine enhancement of the local field at the Pr-nuclei over the external applied field is 7.0 along the c-axis and 14.5 normal to it. Hyperfine enhanced nuclear adiabatic demagnetization experiments starting from 25 mK and 26 kOe yield end temperature as low as 1.3 mK. The nuclear specific heat at 1.8 mK is still relatively low, confirming that exchange interactions are small and suggesting that cooling to even lower temperature should be possible. (Metals Abstr.)

26715 FIELD-INDUCED TRANSITIONS IN DySb. Brun, T. O.; Lander, G. H.; Korty, F. W.; Kouvel, J. S. pp 244-245 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The NaCl-structured compound DySb, which in zero field transforms abruptly at T/sub N/ approximately 9.5^0K to a Type II antiferromagnetic (A) state with a nearly tetragonal lattice distortion, was previously found to exhibit rapid field-induced changes in magnetization at 1.5^0K. The field-induced transitions in a DySb crystal have been studied by neutron diffraction and magnetization measurements in fields up to approximately 60 kOe applied parallel to each of the principal axes. In the (100) case, the transition from the A to an intermediate ferrimagnetic (Q) state is first-order at 4.2^0K (critical field H/sub c/ approximately 21 kOe) but is continuous from approximately 6^0K to T/sub N/, as H/sub c/ yields 0. The Q-to-paramagnetic (P) transition is rapid but continuous at 4.2^0K (H/sub C/ approximately 40 kOe) and becomes broad as T/sub N/is approached. In the (110) case the A-to-Q transition remains essentially first-order from 4.2^0K (H/sub C/ approximately 15 kOe) up to T/sub N/; greater than T/sub N/ rapid P-to-Q transitions occur at very high fields. The magnetic structure of the Q state is found to be that of HoP. (Metals Abstr.)

26716 GALVANOMAGNETIC EFFECTS IN Gd/Co SPUTTERED FILMS. Okamoto, K.; Shirakawa, T.; Matsushita, S.; Sukurai, Y. pp 113-114 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The transverse Hall effect (THE) and the transverse magnetoresistance effect (TME) were measured simultaneously in Gd/Co sputtered films which had the uniaxial magnetic anisotropy perpendicular to the film plane. The results showed that the THE loop is related to the magnetization curve, and that the Hall output voltage, V/sub H/, is proportional to the total area of reversed magnetic domains in the sample. It was also found that the fractional change of resistance, DELTA R/R, depends on the number of magnetic domain walls with which the control current interacts. The magnitude of DELTA R/R is approximately 10^{-4} or less. (Metals Abstr.)

26717 TEMPERATURE DEPENDENCE OF MAGNETIZATION IN AMORPHOUS Gd/Co/Mo FILMS. Hasegawa, R.; Argyle, B. E.; Tao, L. J. pp 110-112 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The temperature dependence of the magnetization of amorphous ferrimagnetic (Gd/sub 1-x/Co/sub x/)/sub 1-y/Mo/sub y/ films prepared by radiofrequency sputtering with x equals 0.79 to 0.88 and y equals 0.08 to 0.16 was studied in the temperature range 4.2 to 500°K. The data, taken using a vibrating sample magnetometer and the polar Kerr effect, were found to be satisfactorily described by Neel's two sublattice model. (Metals Abstr.)

26718 MAGNETISM IN RARE EARTH-TRANSITION METAL AMORPHOUS ALLOY FILMS. Lee, K.; Heiman, N. pp 108-109 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

A number of rare earth (RE) transition metal (TM) amorphous alloy films (RE equals Gd, Ho, Tb, Y; TM equals Co, Fe, Ni, Mn) have been prepared across a broad compositional range by thermal evaporation. The samples were examined by polar Faraday rotation, polar Kerr rotation, and magnetometer techniques. Results show that the major differences between amorphous and crystalline alloys are due to the altered state of the TM. Specifically, the ordering temperature of amorphous RE–Ni and RE–Co alloys is higher than in the corresponding crystalline alloys, whereas the reverse is true for RE–Fe alloys; at the same time, the TM "sublattice" magnetization is larger in the amorphous state for both Fe and Co compounds. Furthermore, amorphous RE–Mn alloys are not ordered. These facts tend to support the general concepts of the charge transfer model. Other properties, such as coercivity and anisotropy, are strongly dependent on the RE constituent. (Metals Abstr.)

26719 "CRITICAL" NEUTRON SCATTERING IN AMORPHOUS $HoFe_2$ AND $GdFe_2$. Pickart, S. J.; Rhyne, J. J.; Alperin, H. A. pp 117-118 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Small-angle neutron scattering measurements were made on amorphous $HoFe_2$ and $GdFe_2$. For $HoFe_2$ the intensity of T greater than or equal to T/sub c/ (195°K) is Lorentzian in form and can be analyzed for an inverse correlation length K_1 which remains finite at T/sub c/. Below T/sub c/ a giant anomalous magnetic component appears, which follows a $q^{-2.4}$ dependence and can be analyzed in terms of magnetic inhomogeneities of dimension comparable to K_1^{-1} at T/sub c/. Limited measurements at fixed q indicate the absence of this component in $GdFe_2$, suggesting an origin based on local crystalline field effects. (Metals Abstr.)

26720 CALORIMETRIC EVIDENCE FOR SPIN FLUCTUATIONS IN UAl_2. Trainor, R. J.; Brodsky, M. B. pp 220-222 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Results of heat capacity measurements on UAl_2 between 1.8 and 400°K are presented. The data are compared with recent resistivity and susceptibility measurements which indicate the existence of localized spin fluctuations in a narrow 5f band. Below approximately 50°K the electronic contribution to the heat capacity become large, equivalent to gamma approximately 70mJ/mole-K^2. Below 6°K there is an upturn in C/T which is proportional to T^2 log T/T/sub SF/, where T/sub SF/ equals 10.6°K is identified as the spin fluctuation temperature. Extrapolation of this term to zero temperature yields m*/m approximately 2 for the spin-fluctuation mass enhancement. At 300°K, UAl_2 exhibits more typical metallic behavior, with gamma approximately 15 mJ/mole-K^2. Data are also presented for nonmagnetic URh_2; at low temperature C equals gamma T + beta T^3, with gamma equals 14.5 mJ/mole-K^2 and beta corresponding to theta/sub D/ equals 336°K. (Metals Abstr.)

26721 ROLE OF ITINERANT 5f STATES ON THE FERMI SURFACE OF Th AND POSSIBLE IMPURITY LOCAL MOMENT FORMATION. Koelling, D. D.; Freeman, A. J. pp 223-224 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The nature (itinerant vs. localized) of the 5f electrons in the actinides determines their magnetic properties. Extensive optical and de Haas-van Alphen data which exist only for Th, the simplest actinide data with no occupied 5f states, allow detailed comparisons to be made between theory and experiment. The 5f bands were found by means of ab initio RAPW energy band calculations, to lie above the Fermi energy, to be itinerant in character and to significantly affect the reflectivity measurements of Veal, et al. The 5f bands, when included in the RAPW calculations, give excellent agreement with the de Haas-van Alphen results of Boyle and Gold, for all sections of the Lungs, Dumbell and Superegg Fermi surfaces, in contrast with calculations based on artificially removing the 5f resonance. Simple overlay charge density impurity scattering potential model calculations are used to discuss the possible occurrence of impurity local moment formation in Th-based alloys. (Metals Abstr.)

26722 PRESSURE EFFECTS ON THE BAND STRUCTURE OF GADOLINIUM. Darby, M. I.; Richardson, N. pp 225-226 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Augmented plane wave (APW) calculations of the band structure of Gd have been made to investigate the effects of decrease in lattice parameters coupled with an increase in c/a ratio. It is found that, compared with normal pressure results, decreasing the lattice constants lowers the bottom of the bands and increasing c/a modified the detailed band structure, particularly near GAMMA. The changes in the density-of-states have been computed and it is found that the Fermi energy is now much closer to the levels near K. It is estimated that the density-of-states at the Fermi energy, and magnetic properties depending on it, are reduced by 15 percent from normal. (Metals Abstr.)

26723 BGS RELAXATION IN THE DILUTE ALLOYS La:Ln. Schreiber, D. S.; Wade, R. F. pp 472-474 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The enhanced relaxation rates $1/T_1$ of ^{139}La in dilute alloys La : Ln, Ln equals Ce, Pr, Nd, Gd or Lu, have been measured and the electronic moment life times have been deduced. (Metals Abstr.)

26724 STRUCTURE TRANSFORMATIONS IN SPUTTER-DEPOSITED Sm_2Co_{17} ALLOYS. Wang, R.; Allen, R. P. pp 683-684 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

A series of structure transformations were observed for thick, sputter-deposited amorphous Sm_2CO_{17} alloys heat treated between 500 and 900°C for 1 h. The amorphous phase crystallized at 500°C to give a $CaCu_5$-type structure with a c/a ratio of 0.86, which is the highest value ever observed for these alloys. With increasing annealing temperature, the c parameter decreased and the a parameter increased, resulting in a continuous reduction of the c/a ratio to a value of 0.84 at 800°C, which is the same as that of the Th_2Zn_{17}-type structure. These struc-

ture transformations and lattice parameter variations are attributed to a progressive change with annealing in the number and degree of order of Sm-atom/Co-atom pair substitutions. Based on a correlation found between the c/a ratio and composition for the $CaCu_5$-type Sm–Co alloys, the metastable phase crystallized from the amorphous state at 500°C has an approximate formula of Sm_2Co_{24} to Sm_2Co_{26}. (Metals Abstr.)

26725 EXCITED-STATE SPIN WAVES, SOFT MODES AND CRYSTAL FIELD EFFECTS. Buyers, W.J.L. pp 27-32 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

There are several branches of the spin-wave spectrum in materials where the exchange and crystalline field are comparable. These effects are illustrated by neutron scattering results for TbSb, where several branches were observed, for $TbAl_2$, where an excited-state spin wave has been directly observed, and for Pr_3Tl where the mode/mode interaction has been found to be responsible in part for the surprising lack of temperature dependence through T/sub c/ of the spin-wave peak. A theory of the dynamical susceptibility has been developed that includes, in RPA, all spin waves allowed within the ground multiplet, and is found to be in good agreement with experiment in contrast to the singlet-singlet or singlet-triplet models. For Pr_3Tl as T yields T/sub c/ the frequencies of the singlet-triplet modes decrease but remain finite. The soft "mode" is a zero-frequency mode that appears in the scattering as a central peak that diverges at the phase transition. The central peak, which arises from localized spin fluctuations, has probably been observed in TbSb. (Metals Abstr.)

26726 MULTIPLET SPLITTING OF X-RAY PHOTOEMISSION SPECTRA CORE LEVELS IN MAGNETIC METALS. Kowalczyk, S. P.; McFeely, F. R.; Ley, L.; Shirley, D. A. pp 207-208 of Magnetism and Magnetic Materials. Graham, C.D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

The results of high resolution x-ray photoemission studies of the multiplet splitting of the 3s core levels in the 3d transition metals and the 4s, 5s and 4d core levels in the lanthanide metals are reported. (Metals Abstr.)

26727 MAGNETOELASTICALLY DRIVEN DOMAIN WALL RESONANCE AT MAGNETIC TRANSITIONS. Vigren, D. T. pp 658-659 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

It is proposed that magnetoelastically driven domain wall resonance is the mechanism by which ultrasonic waves are absorbed near the ferromagnetic-spiral transition of Dy and Tb. Good agreement with the measured attenuation coefficient is obtained on the basis of a simple model. In Ho shear attenuation peaks observed at 24°K, as well as some low-temperature structure in the longitudinal attenuation, appear to be due to this same mechanism. (Metals Abstr.)

26728 LINEAR ELASTIC OBSTACLES: ANALYSIS OF EXPERIMENTAL RESULTS IN THE CASE OF STRESS DEPENDENT PRE-EXPONENTIALS. Surek, T.; Kuon, L. G.; Luton, M. J.; Jones, J. J. pp 629-655 of Magnetism and Magenetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

For the case of linear elastic obstacles, the analysis of experimental plastic flow data is shown to have a particularly simple form when the pre-exponential factor is a single-valued function of the modulus-reduced stress. The analysis permits the separation of the stress and temperature dependence of the strain rate into those of the pre-exponential factor and the activation free energy. As a consequence, the true values of the activation enthalpy, volume and entropy also are obtained. The approach is applied to four sets of experimental data, including Zr, and the results for the pre-exponential term are examined for self-consistency in view of the assumed functional dependence. (Metals Abstr.)

26729 MAGNETIC SUSCEPTIBILITY STUDY OF THE CONTINUOUS DEMAGNETIZATION OF Ce IMPURITIES IN THE (La,Th) Ce SYSTEM. Huber, J. G.; Brooks, J.; Wohlleben, D.; Maple, M. B. pp 475-476 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

Measurements of the magnetic susceptibility as a function of temperature are reported for the (La,Th) Ce system which document directly the continuous demagnetization of Ce impurities which proceeds with increasing Th composition. Cerium impurities can undergo a continuous magnetic-non-magnetic transition when the matrix into which they have been dissolved is subjected to an external pressure or alloyed with another element. This effect was first observed during an experimental investigation of the pressure dependence of the superconducting transition temperature T/sub c/ of LaCe and related systems. It was later found that the continuous demagnetization of Ce impurities could also be included by alloying the La matrix with increasing amounts of Th. This afforded the opportunity to measure various important physical parameters related to the demagnetization of Ce impurities in a matrix at zero applied pressure. (Metals Abstr.)

26730 MAGNETIC ORDERING IN PdGd: ELECTRICAL RESISTIVITY AND MAGNETIC SUSCEPTIBILITY. Cannella, V.; Burch, T. J.; Budnick, J. I. pp 464-465 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

The temperature dependences of the electrical resistivity, rho (T), and the low field magnetic susceptibility, chi (T), were measured for PdGd containing up to 5 at. percent Gd. For alloys containing 2, 3, and 5 at. percent Gd, rho (T) shows a sharp reduction in the spin disorder scattering at the ferromagnetic Curie temperature T/sub c/, obtained from chi (T). Previous electrical resistivity measurements failed to exhibit the effect of magnetic ordering because the high field estimates of T/sub c/ used were significantly larger than the values found. Resistivity data yield estimates of the conduction electron-local moment exchange interaction to be approximately 0.003 eV. (Metals Abstr.)

26731 HYPERFINE FIELDS IN Nd_2Co_{17}, $NdCo_5$, AND $NdCo_3$. Streever, R. L. pp 462-463 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

The nuclear magnetic resonances (NMR) of ^{59}Co, ^{143}Nd and ^{145}Nd have been studied at 4.2°K in the compounds Nd_2Co_{17}, $NdCo_5$ and $NdCo_3$. Cobalt hyperfine fields in these alloys are found to depend on both the alloy and the Co site within a given alloy and vary from 30 to 220 kG. The Nd hyperfine fields are found to be in the range from 3.4 to 4.0 MG. (Metals Abstr.)

26732 OPTIMIZING THE COMBINATION OF MAGNETIC INDUCTION AND YIELD STRENGTH OF VANADIUM PERMENDUR BY HEAT TREATMENT. Fielder, H. C. pp 739-740 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

The high magnetic saturation of V Permendur, a soft magnetic alloy of 2 percent V, 49 percent Co, and 49 percent Fe, makes this alloy particularly useful for laminations in generators and motors when weight is important. The normal heat treatment used to optimize the magnetic properties of this alloy produced a yield strength that was substantially below that required for the high-speed rotor of a generator. Results of a study of the relationship between microstructure and magnetic properties and of the development of a heat treatment that provides a suitable combination of strength and high induction are given. (Metals Abstr.)

26733 INELASTIC MAGNETIC SCATTERING FROM AMORPHOUS $TbFe_2$. Rhyne, J. J.; Price, D. L.; Mook, H. A. pp 121-122 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202–.

Inelastic neutron scattering measurements have been made on sputter-deposited amorphous $Tb_{0.33}Fe_{0.67}$ using time-of-flight spectrometers at Argonne and at Oak Ridge. At 433°K (above

T/sub c/) the magnetic scattering function S(Q, omega) exhibited an approximately Gaussian dependence on energy transfer characteristic of a paramagnet. Below T/sub c/, at 299°K, a broad distribution of magnetic inelastic scattering is present, centered approximately at DELTA E equals 11 meV. As expected, this distribution was significantly broadened and was shifted to a lower energy than the equivalent polycrystalline compound $TbFe_2$ which showed a single inelastic peak near 18 MeV. Polarized beam time-of-flight data taken at Oak Ridge showed evidence for discrete spin wave excitations for Q approximately less than 1.0 A^{-1} in the amorphous sample. (Metals Abstr.)

26734 GENERALIZED SUSCEPTIBILITY OF Sc METAL. Rath, J.; Gupta, R. P.; Freeman, A. G. pp 327-328 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The generalized magnetic susceptibility (q) of Sc metal has been determined from accurate augmented plane wave (APW) method calculations of their energy band structure using a novel computational scheme developed as an extension of the work of Lehmann and Taut and Jepsen and Andersen on the density-of-states problem. The procedure yields simple analytic expressions for the (q) integral inside a tetrahedral microzone of the Brillouin zone which depends only on the volume of the tetrahedron and the differences of the energies only at its corners. Constant matrix element results have been obtained for Sc which show very good agreement with the results of Liu, Gupta and Sinha. (Metals Abstr.)

26735 MAGNETIC PROPERTIES OF THE NEPTUNIUM LAVES PHASES: $NpMn_2$, $NpFe_2$, $NpCo_2$, $NpNi_2$. Aldred, A. T. pp 347-348 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The magnetic properties of the cubic Laves phases (C 15 structure) $NpMn_2$, $NpFe_2$, $NpCo_2$, and $NpNi_2$ have been studied from 4 to 300°K by means of magnetization, neutron-diffraction, and nuclear-gamma-ray resonance (Moessbauer) measurements. The respective ordering temperature (and types of ordering) are 18°K (ferro), approximately 500°K (ferro), 15°K (antiferro) and 32°K (ferro). Magnetic moments are present on the Np atom in all compounds and on the Fe atom in $NpFe_2$. Certain magnetic properties, such as the large anisotropy and the relationship between the magnetic moment and the hyperfine field, are best interpreted in terms of localized 5f electrons, whereas other properties suggest hybridization between the 5f and 3f electrons. (Metals Abstr.)

26736 MAGNETIC PROPERTIES OF URANIUM AND PLUTONIUM LAVES PHASES WITH 3d TRANSITION ELEMENTS. Lam, D. J.; Aldred, A. T. pp 349-350 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The magnetization of UMn_2, UFe_2, UCo_2, UNi_2, $PuMn_2$, $PuFe_2$, $PuCo_2$, and $PuNi_2$ was measured from 4 to 300°K in fields up to 14 kOe. The susceptibility of UMn_2 shows a small maximum near 240°K (which may indicate an antiferromagnetic transition), in agreement with previous results. Data for UFe_2, UCo_2, and UNi_2 are not in good agreement with earlier work; the ferromagnetic ordering temperature (158°K) of a single-crystal sample of UFe_2 is lower than any reported value, UNi_2 orders ferromagnetically at 30°K and UCo_2 may order less than 5°K. In contrast, $PuMn_2$, $PuCo_2$ and $PuNi_2$ have small weakly temperature-dependent susceptibilities. $PuFe_2$ is ferromagnetic at room temperature, in agreement with previous Moessbauer results, and has a saturation moment of approximately 2.6 mu/sub B//mole. (Metals Abstr.)

26737 HIGH-FIELD SUSCEPTIBILITY IN FERROMAGNETIC $NpOs_2$. Dunlap, B. D.; Aldred, A. T.; Lam, D. J.; Davidson, G. R. pp 351-352 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

$NpOs_2$ is known to be a ferromagnet with a Curie temperature of 7.5°K. Previous bulk magnetization measurements indicated a field-induced magnetization even well below the transition temperature. By a measurement of the local high-field susceptibility, using the Moessbauer effect in ^{237}Np, a susceptibility of (1.2 +- 0.2) x 10^{-2} emu/mole at 1.6°K is obtained, in general agreement with the bulk measurement. Such a large susceptibility is best understood by a model f itinerant magnetism, although other properties of the material indicate localized behavior. (Metals Abstr.)

26738 MAGNETIC ENTROPY AND MAGNETIZATION OF $ZrZn_2$. Viswanathan, R.; Clinton, J. R. pp 416-417 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

The previously published low-temperature heat capacity data of four $ZrZn_2$ samples were analyzed to extract the magnetic entropy, S/sub m/(T). The well-ordered vapor-deposited $ZrZn_2$ with T/sub c/ approximately 22°K showed a finite but small S/sub m/(T) of 110 mJ/gm mole K, indicating that it is very much an itinerant electron ferromagnet. However, the dramatic increase of S/sub m/(T) with the increase of Curie temperature suggests that the better the samples the more the deviation from the Stoner–Wohlfarth band theory. The magnetic measurements, carried out on the same sample, confirm the general applicability of the band theory and the sensitivity of the samples to the details of preparation and heat treatment. (Metals Abstr.)

26739 FERMI SURFACE 'NESTING' IN Tb ALLOYS. Burgardt, P.; Legvold, S. pp 418-419 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Magnetization and electrical resistivity measurements from 4.2 to 300°K have been made on alloys of Tb with Th, Mg, and Yb to test valency effects on magnetic ordering in Tb. Tetravalent Th raises E/sub E/ and promotes ferromagnetism by reducing the "nesting" feature in the Tb Fermi surface. Divalent Mg and Yb lower E/sub F/ to enhance the "nesting" feature and promote the helical structure. The results are understood in terms of valency effects on the Fermi surface and impurity size effects. (Metals Abstr.)

26740 MAGNETIC SUSCEPTIBILITY MEASUREMENTS ON ACTINIDE-Be_{13} INTERMETALLIC COMPOUNDS. Brodsky, M. B.; Friddle, R. J. pp 353-354 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Magnetic susceptibilities have been measured between 2 and 300°K for the compounds $AnBe_{13}$ (An equals Th, U, Np, Pu), all of which form the $NaZn_{13}$ structure. The susceptibility of $ThBe_{13}$ is temperature-independent. The data for UBe_{13}, $NpBe_{13}$ and $PuBe_{13}$ may follow two Curie–Weiss regions with the breaks occurring at 200 and 70°K, respectively. The Curie–Weiss parameters are not substantially different for the two regimes. The intermediate coupling scheme yields $5f^3$, $5f^4$, $5f^5$ configurations for the U, Np, and Pu compounds, respectively. Thus, each actinide ion is trivalent if the f-electrons are considered to be localized. Of these compounds, only $PuBe_{13}$ gives evidence for long-range magnetic order, becoming antiferromagnetic at T/sub N/ equals 11.5°K. (Metals Abstr.)

26741 EFFECTS OF MECHANICAL PROPERTIES ON FATIGUE CRACK GROWTH RATES IN Fe–Ni AND Fe–Mo ALLOYS. Burck, L. H. Chicago; Northwestern Univ. (1975). 120p. University Microfilms Order No. 75-29,589.

Thesis (Ph. D.).

Fatigue crack propagation data was obtained for iron and solid solution alloys of Fe–Ni and Fe–Mo over the temperature range 77 to 296°K, i.e., through the ductile-brittle transition temperature for most of the alloys. The fatigue crack growth rates were found to decrease with decreasing temperature for each alloy and to decrease with increasing solute content at 296°K but to increase with solute content at 77°K. These results are discussed in terms of the wide range of mechanical properties observed for these materials. It is shown that the transgranular fatigue crack growth rates are inversely proportional to an effective surface energy and the square of a stress approximated by the yield or ultimate stress. The iron and Fe–Mo alloys showed extensive cyclic hardening whereas the much finer grained Fe–Ni alloys showed softening at low strain ranges and only moderate hardening at higher strain ranges. This cyclic stress-strain behavior is shown to be significant in relation to the high cycle fatigue crack growth rates. (Diss. Abstr. Int., B)

26742 TRANSFER PHENOMENA IN THE EUTECTIC LAYER InSb–MnSb. Aliev, M. I.; Dzhabborov, R. M.; Alieva, M. A. (Inst.

of Physics, Baku). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 969-971(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1135-1137(Jun 1975).

The temperature dependencies of the electric conductivity and Hall effect of InSb–MnSb alloy at 80 to 430°K were investigated. It was found that InSb–MnSb is a ferromagnetic material and that the ferromagnetic properties are manifested when the external fields (electric, magnetic, and thermal) are parrallel to acicular inclusions found in the matrix. (JRD)

26743 SYSTEM Ge–In–Ga. Kuznetsova, S. K.; Shkalikova, K. I.; Kuznetsov, G. M. (Inst. of Steel and Alloys, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 868-870(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1016-1019(Jun 1975).

Using microscopic and x-ray phase analysis, alloys of the system In–Ga containing up to 2 wt. % Ga were investigated. The solidus curve of the solid solution based on α_{In} has a retrograde character. The maximum Ga content of the solid solution α_{In} is 1.82 at.% at 100°C. The polythermal cross sections Ge–In + 0.82 at.% Ga and Ge–In + 1.63 at.% Ga have been constructed.

26744 MAGNETIC SUSCEPTIBILITY AND NEGATIVE MAGNETORESISTANCE OF MANGANESE-DOPED INDIUM ANTIMONIDE. Andrianov, G. V.; Lazareva, G. V.; Savel'ev, A. S.; Selyanina, V. I.; Fistul, V. I. Fiz. Tekh. Poluprov.; 9: No. 8, 1555-1560(Aug 1975). (In Russian).

The magnetic susceptibility and negative magnetoresistance of InSb single crystals grown by the Czochralski method and heavily doped with Mn were studied experimentally and the results were compared with theory. Analysis of the magnetic susceptibility confirmed that in these crystals the Mn existed in the $3d^5$ state. The negative magnetoresistance characterizing these samples was associated with the spin scattering of holes at the magnetic moments of the Mn ions. The observed negative magnetoresistance closely followed the theoretical (semi-empirical) equation as a function of magnetic field. (Metals Abstr.)

26745 STRUCTURE OF THE ELECTRICAL DOUBLE LAYER ON AN INDIUM–GALLIUM EUTECTIC ALLOY AT NEGATIVE SURFACE CHARGES AND THE INFLUENCE OF THE NATURE OF THE ALKALI METAL CATIONS ON THE SPECIFIC ADSORPTION OF CHLORIDE IONS. Kalyuzhnaya, A. M.; Grigor'ev, N. B.; Bagotskaya, I. A. Elektrokhimiya; 10: No. 11, 1717-1721(Nov 1974). (In Russian).

An ac bridge method was used to measure the differential capacity at frequencies from 310 to 10,000 Hz on an In–Ga alloy in solutions of various cations, namely Li^+, Na^+, K^+ and Cs^+. The higher values of the capacity on In and the In–Ga alloy compared with Ga and Hg were evidently connected with the different distribution of electron density in the surface layer on these metals. In acetonitrile in comparison with water the distance between the deposits of the double layer was larger and these factors had less influence on the magnitude of the capacity of the dense part of the double layer. In chloride solutions the potential of zero charge of the In–Ga alloy depended on the nature of the cation and was displaced towards more negative values in the order LiCl < NaCl, KCl < CsCl. After a correction was introduced for the value of the diffusion potential, the data were in semiquantitative agreement with values calculated from the differential-capacity values given. (Metals Abstr.)

26746 EFFECT OF HEAT TREATMENT ON THE ELECTRICAL CHARACTERISTICS AND IMPURITY PHOTOCONDUCTIVITY OF p-InSb. Balyashko, E. G.; Pleskacheva, T. B.; Tyapkina, N. D. (Moscow State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 11: No. 6, 871-875(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 11: No. 6, 1020-1025(Jun 1975).

The effects of annealing in vacuum on the electrical parameters, absorption spectra, and photoconductivity of Ge-doped p-InSb were investigated. From the absorption and photoconductivity spectra the positions of three deep levels, $E_1 = 0.103$ eV, $E_2 = 0.067$ eV, and $E_3 = 0.048$ eV were determined.

26747 MECHANISM FOR COERCIVITY IN SPLAT-COOLED RCo_5 COMPOUNDS. Ziai, E.; Kim, Y. B. pp 685-686 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Splat-cooling technique is used to prepare fine powders of certain RCo_5 compounds. Splat-cooled materials are shown to have large concentrations of grain boundaries. These powders have magnetic properties which are different from those of the powders produced by mechanical comminution. In particular, the instrinsic coercivities of $PrCo_5$ and $MMCo_5$ are increased significantly by splat cooling, while their maximum energy products are reduced. Heat treatments of splat-cooled powders, which reduce the density of grain boundaries, increase coercivity slightly but a large increase takes place in the maximum energy product. Mechanical grinding of splat-cooled materials produces similar effects, although this time it is due to the deliberate introduction of defects which act as pinning centers. By analyzing the hysteresis curves of as-ground, splat-cooled and heat treated or ground splat-cooled $SmCo_5$ it is concluded that in the splat-cooled materials a nucleation mechanism is dominant in the initial stages of the magnetization reversal process. Nucleation takes place at the grain boundaries which are in abundance. (Metals Abstr.)

26748 USE OF THE MECHANICAL EQUATION OF STATES TO PREDICT THE BEHAVIOUR OF 20 Cr–25 Ni–Nb STAINLESS STEEL NUCLEAR FUEL CLADDING. Gittus, J. H. (UKAEA, Springfields, Eng.). pp 155.1-155.5 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Stress-analysis techniques such as the finite-element method demand prediction techniques capable of forecasting creep-rate as a function of the instantaneous and previous values of temperature and stress at each node. To supply this requirement, for metals that creep by dislocation-movement, a Mechanical Equation of States (MEOS) has been developed from the theory of dislocation-interactions and compared with creep data. Parameter-values for the MEOS have been determined, in the case of a stainless steel, by stress-removal and stress-reversal (creep-fatigue) experiments. Both the plastic and anelastic (recoverable) components of creep-strain are predicted by the MEOS for any arbitrary history of temperatures and multiaxial stresses. Its predictions compare well with results of stress-dip experiments. By generalizing to the multiaxial case, an algorithm is produced which solves the MEOS. Input data for stainless steel are tabulated. The predicted multiaxial strain-time behavior is presented for a stainless steel nuclear fuel cladding tube subjected to a stress temperature history similar to that expected in service. (auth)

26749 DEVELOPMENT OF ELEVATED TEMPERATURE FATIGUE DESIGN INFORMATION FOR TYPE 316 STAINLESS STEEL. Jaske, C. E.; Mindlin, H.; Perrin, J. S. (Battelle Columbus Labs., OH). pp 163.1-163.7 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

To develop material properties information for use in elevated-temperature fatigue design, an extensive study of the fatigue and stress-strain behavior of Type 316 stainless steel was conducted at temperatures from 21 to 649°C. Fatigue life and cyclic stress-strain curves were developed. Creep-fatigue interaction was evaluated by conducting strain hold-time tests at 566 and 649°C. Hold periods at peak tensile strain produced a large reduction in cyclic life. It was found that both a linear damage rule and the strain-partitioning method could be used to assess cumulative creep and fatigue damage. Aging for 1000 h at test temperature before testing caused only small or no changes in continuous cycling fatigue resistance at 566 and 649°C and in tension hold-time fatigue resistance at 566°C. This aging produced a significant increase in tension hold-time fatigue resistance at 649°C. (auth)

26750 APPLICATION OF REGRESSION ANALYSIS TO CREEP OF SPACE SHUTTLE MATERIALS. Rummler, D. R. (Langley Research Center, Hampton, VA). pp 164.1-164.6 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Metallic heat shields for Space Shuttle thermal protection systems must operate for many flight cycles at high temperatures in low-pressure air and use thin-gage (less than or equal to 0.65 mm) sheet. Available creep data for thin sheet under those conditions are inadequate. To assess the effects of oxygen partial pressure and sheet thickness on creep behavior and to develop constitutive creep equations for small sets of data, regression techniques are applied and discussed. (auth)

26751 CREEP AND CREEP-RUPTURE PROPERTIES OF TYPE 316 STAINLESS STEEL CLADDING TUBES FOR THE EXPERIMENTAL FAST BREEDER REACTOR JOYO. Yoshida, S. (National Research Inst. for Metals, Tokyo); Tancha, C.; Ichino, I.;

Uematsu, K. pp 166.1-166.6 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Creep and creep-rupture tests under a biaxial loading condition obtained by internally pressurizing with argon gas and uniaxial tension were performed in the unirradiated and atmospheric condition of four heats of Type 316 stainless steel cladding tubes for the Experimental Fast Breeder Reactor JOYO at test temperatures of 600, 650, 700, and 750°C. The data obtained were analyzed by a statistical procedure using the Larson-Miller parameter. The correlation between the results of the biaxial loading tests and those of the uniaxial tension tests was examined. The present data were also compared with the other standard creep-rupture data on the same material. (auth)

26752 LOW-CYCLE FATIGUE RESULTS FOR SPOT-WELDED AISI 316 STAINLESS STEEL STRIP AT ELEVATED TEMPERATURES. Flagella, P. N.; Hundal, R. (Westinghouse Electric Corp., Madison, PA). pp 167.1-167.10 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Results are reported for load-controlled, low-cycle fatigue experiments conducted on spot-welded AISI 316 stainless steel strip (0.25 mm thick) at room temperature, 538, 621, and 704°C in air. A detailed study evaluating the effects of hold time in tension at 621°C was also performed. Three distinct frequency regions, related to cycle dependent (fatigue) and time dependent (creep) failures, were identified. The high frequency region (1 to 200 cycles/min) cycles to failure was essentially independent of frequency and hold time. The intermediate frequency region involved fatigue-enhanced creep and is described by a power law expression. The low frequency region is described by the creep-rupture life. Metallographic observations identify different fracture modes consistent with cycle dependent and time dependent regions. (auth)

26753 TOWARDS THE STANDARDIZATION OF TIME-TEMPERATURE PARAMETER USAGE IN ELEVATED TEMPERATURE DATA ANALYSIS. Goldhoff, R. M. pp 174.1-174.8 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Work devoted to establishment of recommended practices for correlating and extrapolating relevant data on creep-rupture properties of materials at high temperatures is described. An analysis of the time-temperature parameter is included along with descriptions of analysis and evaluation methods. Results of application of the methods are compared. (JRD)

26754 LOW CYCLE FATIGUE BEHAVIOUR OF ZIRCONIUM ALLOYS AT 300°C. Hosbons, R. R. (Chalk River Nuclear Labs., Ont.). pp 176.1-176.6 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

The low cycle fatigue lives of two zirconium alloys, zirconium–2.5 wt percent niobium and zirconium–1.1 wt percent chromium–0.1 wt percent iron, have been determined at 300°C. Both annealed material and cold-worked and stress-relieved material have similar fatigue lives to annealed Zircaloy-2 but beta-quenched zirconium–niobium and zirconium–chromium–iron have lower fatigue lives than annealed Zircaloy-2. An atmosphere containing a concentration of iodine lower than that required for stress corrosion cracking still significantly lowers the fatigue life. A mathematical relationship between fatigue life and short-term tensile properties was used to estimate the fatigue life of zirconium alloy fuel sheaths and it was estimated that for a strain cycle of 0.1 percent a cyclic frequency exceeding 0.116 Hz (10,000 cycles/day) would be required to cause fatigue failure of the sheath before its design life is realized. (auth)

26755 STUDY OF PRECIPITATION PHENOMENA DURING THE CREEP OF AUSTENITIC STAINLESS STEELS. Le May, I. (Univ. of Saskatchewan, Saskatoon); Bassett, B. J.; White, W. E. pp 178.1-178.6 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Creep-rupture data for two austenitic stainless steels, AISI Types 310 and 316, are presented, together with observations of precipitation taking place during creep. While the effects of creep deformation on precipitation in the Type 310 were negligible, ferrite precipitation was considerably greater in the Type 316 undergoing creep than in unstressed material. Ferrite precipitation appears to promote grain boundary cavitation and internal cracking, thus reducing creep resistance and a correlation has been noted between increased ferrite precipitation and apparent further weakening of the Type 316 over the temperature range 730 to 800°C approximately, as evidenced by breaks in the isostress lines on a plot of log (time to rupture) versus temperature. (auth)

26756 OBSERVATIONS AND INTERPRETATION OF CRACK PROPAGATION UNDER CONDITIONS OF TRANSIENT THERMAL STRAIN. Mowbray, D. F.; Woodford, D. A. (General Electric Co., Schenectady, NY). pp 179.1-179.11 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Tapered disk thermal fatigue tests have been conducted on one nickel-(Rene 77) and one cobalt-(FSX 414) base alloy. Measurements of crack length as a function of number of thermal cycles were made on cracks growing from notches machined on the specimen periphery. The effect on crack propagation of peripheral radius (strain range), maximum temperature between 1093 and and 1343°K, and hold time at maximum temperature between 1 and 60 min is reported. The responses of both alloys showed identical trends in that increasing hold time or maximum temperature first caused an increase in the measured crack growth rate, DELTA a/DELTA N, but then showed a decrease at long hold times or high temperatures. It is proposed that in both alloys there are two competing processes occurring, namely a cycle dependent creep/environmental damage at the crack tip and a time-dependent microstructural change resulting in enhanced crack propagation resistance with accumulated time at temperature. Direct microstructural evidence is presented for two such processes in Rene 77. The first process is believed to be reflected by the width of the gamma' denuded zone adjacent to the crack, which is largely dependent on the hold time in a single cycle rather than on the accumulated time. The second involves a coarsening of the gamma' precipitate and development of a gamma' grain boundary envelope observed at long times which could account for the decrease in crack growth rate. The measured effect of hold time at temperature and the observed microstructural features point to the major crack advance occurring during the heating shock and holding period rather than at the maximum tensile stress which develops during the cooling shock. This conclusion is supported by a non-linear analysis of the disk periphery which shows that, because of the reversed plastic flow, a tensile stress develops at and near the highest temperature in the cycle. (auth)

26757 CREEP PROPERTIES OF A TYPE 308 STAINLESS STEEL PRESSURE VESSEL WELD WITH CONTROLLED RESIDUAL ELEMENTS. King, R. T.; Stiegler, J. O.; Goodwin, G. M. (Oak Ridge National Lab., TN). pp 181.1-181.7 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

A SMA Type 308 stainless steel pressure vessel test weld with the CRE (controlled residual elements) boron (0.007 percent), titanium (0.06 percent), and phosphorus (0.04 percent) has been tested in creep between 482 and 650°C. Improved ductility compared with that of standard welds in tests lasting several thousands of hours is observed. Systematic variations of creep properties through the weld are due to thermal and mechanical cycling during the welding process. Anisotropic deformation related to local substructure and preferred crystallographic orientation occurs. Creep strengths are acceptable by present design rules. (auth)

26758 COMPREHENSIVE CHARACTERIZATION OF THE HIGH TEMPERATURE FATIGUE BEHAVIOR OF A286. Henry, M. F.; Solomon, H. D.; Coffin, L. F. Jr. (General Electric Co., Schenectady, NY). pp 182.1-182.7 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

The high strain fatigue behavior of A286 at 1100°F is examined in a multi-faceted program. The program includes phenomenological studies on life prediction in smooth bars and on crack propagation in single-edge-notched specimens. It is shown that the life-prediction equations can be used to account for frequency, wave shape (including hold times) and notches. Environment is shown to have a strong effect on the fatigue life when cyclic frequency is varied. Studies from a metallurgical viewpoint are presented on fatigue crack nucleation and propagation. Nucleation and propagation mechanisms are found to be transgranular and intergranular at high and low frequencies respectively. It is shown that the strain range partitioning concept is inapplicable for A286 at 1100°F, due most probably to the strong environmental interaction. Key areas are pointed out where information is still lacking. (auth)

26759 DESIGN CRITERIA AND PRESSURE VESSEL CODES: AN AMERICAN VIEW. Tuppeny, W. H. Jr. (Combustion Engineering, Inc., Windsor, CT). pp 184.1-184.7 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

To the pressure vessel designer, codes and criteria represent the common ground where the stress analyst and the metallurgist must interact and evolve rules and procedures which will insure safety and open-ended responsiveness to technological, economic, and environmental change. The evolution and rationale behind the current ASME codes sections are discussed emphasizing those portions applicable to designs operating in the creep range. A plan of action is proposed so that the analysts and materials people can make optimum use of time and resources, and evolve data and design criteria which will be responsive to changing technology and the economic and safety requirements of the future. (auth)

26760 INVESTIGATION INTO THE LOW CYCLE FATIGUE OF TYPE 321 STAINLESS STEEL STUDS SUBJECTED TO LARGE STRAIN CONTROLLED BENDING IN THE CREEP RANGE. Bolton, W. K. (Frazer-Nash (Consultancy) Ltd., Kingston-on-Thames, Eng.); Suhr, R. W.; Wilkinson, P. R. pp 191.1-191.9 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Type 321 stainless steel studs are employed to provide a four stud fixing arrangement for an insulation coverplate on the pressure vessel wall of a gas cooled nuclear reactor. The coverplate expands under a temperature of 650°C and deflects the hot end of the studs into a yield condition. As the coverplate is thermally cycled, the studs are subjected to high strain low cycle fatigue in the creep range with dwell periods at either end of the strain cycle. Details of a theoretical and experimental investigation of the stud behavior under these conditions are given. The evolution of a satisfactory design from this study is described. A theoretical limit analysis of the stud load-deflection characteristic, based on plastic hinge considerations is presented. This analysis gave a good correlation with experimental results for both strain controlled bending and creep relaxation and provided an understanding of the fatigue mechanism. The experimental results were dominated by the interaction of creep and fatigue which produced two different, but interacting zones of failure. This is discussed in detail and experimental results presented of the tests which were carried out for different dwell times, strain ranges, material ductility, and designs of the critical stud to coverplate fixing geometry. The results reported relate to a stress situation well beyond that covered by present design codes. The difficulties in establishing reliable fatigue data in the presence of major variables, notably dwell time, in the creep range are clearly demonstrated. This study shows how a suitable design solution can be achieved under such circumstances when analytical and experimental work are directed towards a basic understanding of the mechanisms involved. (auth)

26761 FREQUENCY INTERPRETATION OF HOLD-TIME EXPERIMENTS ON HIGH TEMPERATURE LOW-CYCLE FATIGUE OF STEELS FOR LMFBR. Udoguchi, T. (Tokyo Univ.); Asada, Y.; Ichino, I. pp 211.1-211.9 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

The effect of frequency or hold-time on the low-cycle fatigue strength of AISI 316 stainless steel and SCM 3 Cr-Mo steel for fuel cladding, piping, and other structural members of LMFBR is investigated under high temperature conditions. Push-pull fatigue tests are conducted in air under conditions of fully reversed axial strain-control with a tensile strain hold-time ranging from 0 to 120 min for AISI 316, and with a tensile and an equal compressive strain hold-time ranging from 0 to 995 s for SCM 3. In these tests, a decrease of fatigue life is observed as the hold-time is increased. An empirical formula is presented which can predict well the effect of hold-time on high temperature low-cycle fatigue life in terms of frequency. The formula is a little different from those in the literature. (auth)

26762 NON-LINEAR CREEP FATIGUE ANALYSIS OF A SODIUM HEAT EXCHANGER COMPONENT FOR THE FAST FLUX TEST FACILITY. Gangadharan, A. C.; Pai, D. H.; Berman, I. (Foster Wheeler Corp., Livingston, NJ). pp 215.1-215.8 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

An analysis is presented of a metallic component subjected to pressure loads and severe thermal transients operating in the range in which creep is significant. The analysis is applied to 304 stainless steel heat exchangers for FFTF. Information is included on analysis methods, design requirements, and use of finite element program MARC-II. (JRD)

26763 COMPARISON OF THE STRAIN-CONTROLLED LOW CYCLE FATIGUE BEHAVIOR OF STAINLESS TYPE 304/308 WELD AND BASE MATERIAL. Brinkman, C. R.; Koth, G. E.; Beeston, J. M. (Aerojet Nuclear Co., Idaho Falls, ID). pp 218.1-218.11 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Results are reported from strain-controlled fatigue tests conducted on uniform gage specimens taken from several different positions and orientations with double-U groove heavy section stainless Type 304/308 weldments. Room temperature and 593°C test results are reported from strain-controlled fatigue, cyclic stress-strain, and elastic anisotropy measurement tests. The fatigue resistance of the weldment material was found to be inferior to that of base material at room temperature; however, the degree to which it was inferior was specimen orientation dependent. At 593°C specimens taken from a parallel orientation with respect to the weld seam exhibited a fatigue resistance that was nearly equivalent to that of the base material. Transverse and transverse fusion line material showed inferior resistance to base material at both room temperature and 593°C, however, comparison was difficult due to strain concentrations that occurred in the transverse weldment material. Extensive variations in apparent elastic properties, i.e., Young's modulus and Poisson's ratio were found to occur in weldment material at both room temperature and 593°C. (auth)

26764 PRESSURE TESTS TO ASSESS THE SIGNIFICANCE OF DEFECTS IN BOILER AND SUPERHEATER TUBING. Guest, J. C. (Tube Investments S.T.D. Services Ltd., Aldridge, Eng.); Hutchings, J. A. pp 221.1-221.10 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Internal pressure tests on 9 percent Cr-1 percent Mo steel tubing containing artificial defects demonstrated that the resultant loss of strength was less than a simple calculation based on the reduced tube thickness would suggest. Bursting tests on tubes containing longitudinal defects of varying length, depth and acuity showed notch strengthening at ambient temperature and at 550°C. A flow stress concept developed for simple bursting tests was shown to apply to creep conditions at 550°C. Results of creep and short-term bursting tests show that the length as well as the depth of the defect is an important factor affecting the life of bursting strength of the tubes. Defects less than 10 percent of the tube thickness were found to have an insignificant effect. (auth)

26765 STATIC AND CYCLIC CREEP PROPERTIES OF THREE FORMS OF A CAST NICKEL ALLOY. Harrison, G. F. (National Gas Turbine Establishment, Pyestock, Eng.); Tilly, G. P. pp 222.1-222.9 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

The static and cyclic creep properties of conventionally cast, directionally solidified and single crystal forms of a cast nickel superalloy, Mar M246, have been evaluated at 850 and 900°C. Tensile and compressive creep curves have been obtained at constant stress and the results analyzed using power law creep terms. Typically, directionally solidified specimens have tensile lives twice those of comparable conventionally cast materials, and rupture strains three or four times greater. Increase in specimen size raised the life of conventionally cast material but had no effect on single crystals. Differences between tensile and compressive creep properties were accentuated in the tertiary stages of deformation. No improvement in compressive creep resistance was obtained using directionally solidified or single crystal specimens. Equations developed previously from strain hardening theory gave an accurate estimation of behavior under cyclic tension. This theory has been extended to include push-pull loading and is shown to give a satisfactory correlation with the data. (auth)

26766 CAPABILITY OF AUSTENITIC STEEL TO WITHSTAND CYCLIC DEFORMATIONS DURING SERVICE AT ELEVATED TEMPERATURES. Etienne, C. F.; Dortland, W.; Zeedijk, H. B. (TNO, Apeldoorn/Zeud, Netherlands). pp 225.1–225.9 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Safe design for structures with steels for elevated temperatures necessitates screening these materials on the basis of objective criteria for ductility, besides screening them on elevated temperature strength. Because creep and fatigue damage may occur during operation, the ductility of a steel after a long operation time is more important than the ductility in the as delivered condition. Results of an investigation into the ductility of austenitic Cr–Ni-steels are described. In order to determine the capability of the steels to withstand cyclic plastic deformations in the aged condition, various aging treatments were applied before determining the ductility in low-cycle fatigue testing. Correlating the ductility with the sizes of the carbide precipitates made it possible to predict the ductility behavior during long service times. This led to the conclusion that for an austenitic steel with a high thermal stability (17.5 percent Cr–11 percent Ni) the ductility can decrease considerably during service at elevated temperature. Nevertheless it is expected that the remaining ductility of such steels in aged condition will be amply sufficient to withstand the cyclic deformations that occur during normal service. (auth)

26767 DESIGN METHODS FOR STRUCTURES UNDER THERMAL RATCHET. Branca, T. R.; McLean, J. L. (Teledyne Materials Research, Waltham, MA). pp 228.1–228.7 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Previous work on the thermal ratchet analysis of a simple pipe is extended to the case of an intersection of a pipe with a spherical shell. The chosen nozzle configuration is subjected to an internal pressure which remains constant, and a cyclic thermal transient which is representative of the type of transient that might be expected for components of a LMFBR. A number of cross-sections through the nozzle were examined, each yielding a different combination of elastic primary and secondary stress. These stresses, together with their associated cyclic strain growth, as determined from an elastic-plastic-creep analysis of the nozzle, were then plotted on a Miller or Bree-type diagram. Thus, a number of points, one for each cross-section considered, were available for comparison with the data obtained from the ratchet analysis of simple pipe sections. Both the elastic and inelastic analyses on the nozzle were performed using the finite element method of structural analysis of the ANSYS computer code. The pipe ratchetting cases were computed using the Oak Ridge National Laboratory PLACRE code. For a sample pipe ratchet case, a brief comparison is given between the version of ANSYS used in this study, the ANSYS version used in the previous work and the PLACRE code. The three programs did not yield identical results. Further study is needed to resolve the discrepancies that were observed. The results of the comparison between the nozzle ratchet and pipe ratchet solutions indicate that reasonable predictions can be made for the nozzle ratchet strains based on elastic parameters and design curves developed from pipe ratchetting solutions. (auth)

26768 APPLICABILITY OF FRACTURE MECHANICS TO ELEVATED TEMPERATURE DESIGN. McEvily, A. J.; Wells, C. H. (Pratt and Whitney Aircraft, Middletown, CT). pp 230.1–230.7 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

In recent years consideration has been given to the extension of fracture mechanics to safe design in the creep range. The experimental work which has been carried out at elevated temperatures within the fracture mechanics framework is reviewed. Most of these studies deal with the rate of fatigue crack growth as a function of the stress intensity factor, with temperature, frequency, and environment being the principal test variables. It is concluded that although the approach is still in an early stage of development it has considerable potential as a design procedure within certain limitations. The nature of these limitations is discussed. (auth)

26769 SOME ASPECTS OF ELEVATED TEMPERATURE BEHAVIOR OF A 1 PERCENT Cr–Mo–V STEEL. Darlaston, B. J. (Cambridge Univ., Eng.); Miller, K. J.; Stanley, P. pp 232.1–232.9 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

A collaborative program is being pursued by the CEGB together with the Engineering Departments of the Universities of Belfast, Bristol, Cambridge, and Nottingham on the behavior of a Cr–Mo–V steel at high temperature. The aim of the program is to establish methods of predicting failure under combined creep-fatigue conditions. Such is the magnitude of the exercise that interim reporting is essential. Attention is drawn to the program being pursued and the results obtained so far by three of the establishments involved are presented. (auth)

26770 ANALYSIS TECHNIQUES FOR ELEVATED TEMPERATURE APPLICATIONS. Lewis, D. J.; Hellen, T. K. (Central Electricity Generating Board, Berkeley, Eng.). pp 233.1–233.17 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Some of the more generally used methods of analysis of stress and strain in structures at elevated temperatures are reviewed, with particular emphasis on finite element methods. It is shown that where sufficiently large computers are available, and where cost is not a severe limitation, creep and plasticity behavior can be computed for a wide range of components. Where these effects are encountered simultaneously, more knowledge of materials behavior is required. Calculation of stress and strain is usually only a means to the designer's main aim, which is proving the life and integrity of his structure. The shortcomings of computational methods in this respect are discussed, and a brief review given of the "short cut" methods of life assessment available to the designer. (auth)

26771 OPERATION OF WAGR SUPERHEATER HEADERS IN THE CREEP RANGE. Crook, C. E.; Stewart, G. (British Nuclear Fuels Ltd., Windscale, Eng.). pp 239.1–239.9 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

The Windscale Advanced Gas Cooled Reactor of the UKAEA is a prototype reactor. A decision to reverse the steam flow in the superheater banks of the heat exchangers resulted in a reversal of duties for the inlet and outlet headers. The original mild steel inlet headers were thus required to operate in the creep range at temperatures of the order of 450°C. A Code approach to the assessment of potential life was found to be inadequate for the purposes of system optimization and so stress-rupture data were analyzed by a method which related failure probabilities to the operating parameters of stress and temperature. While the absolute values of the derived numbers can be debated, it is believed that the method gives a feel for the changes of risk with variations in operating conditions. The method offers the considerable advantage of improving communications during inter-disciplinary discussions. New operational limits were established and, as a prudent check on predictions, header performance was monitored using a combination of strain measurement and ultrasonic testing during the annual shutdowns. The creep strains developed during service were measured at ambient temperatures at shut-down by replication of orthogonal grids previously scratched on the header surfaces. These data were used to normalize predictive expressions originally derived from laboratory data and strain predictions are now made with some considerable confidence. On a basis of the original failure probability analysis, the rate of development of strain and the results of ultrasonic testing, the need to change the

headers appears to be unlikely within the presently planned lifetime of the reactor. (auth)

26772 SHALLOW IMPURITY STATES IN InSb IN MAGNETIC FIELDS: HIGH-FIELD DONOR STATES AND ACCEPTOR STATES. Lin-Chung, P. J.; Henvis, B. W. (Naval Research Lab., Washington, DC). Phys. Rev., B; 12: No. 2, 630-640(15 Jul 1975).

The high-field donor and acceptor states associated with Landau ladders are determined using the effective-mass approximation. Nonparabolic effects as well as band-band interaction are included in this calculation. Based on the calculated results, the coexisting feature of the Landau series and Rydberg series is reexamined. A quantitative comparison with the magneto-optical measurements is made in order to obtain information about the central-cell correction and nonparabolic effects. Selection rules for optical transitions and Raman transitions are also derived. (auth)

26773 POSITRON TRAPPING IN SOLID AND LIQUID METALS. Triftshaeuser, W. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev., B; 12: No. 11, 4634-4639(1 Dec 1975).

Measurements of the peak counting rate in the angular correlation curve of positron annihilation radiation have been performed in the solid and liquid phase of indium, lead, and aluminum, and in the solid phase of magnesium, as a function of temperature. In the solid phase In, Pb, and Al show at low temperatures the thermal-expansion effect and at higher temperatures in addition the positron-trapping effect. At the melting point the peak counting rate increases abruptly and stays then constant with temperature. This behavior in the liquid phase is interpreted as "saturation trapping," i.e., all positrons annihilate from a trapping site and the thermal expansion of the lattice is not effective for these positrons. Trapped positrons are effectively "shielded" from the thermal expansion of the lattice. Therefore, it is possible to separate the thermal-expansion effect from the vacancy-trapping effect and very accurate values for the monovacancy formation energy can be obtained. A difference was found in the nature of trapping sites in solid and liquid aluminum. Magnesium shows only the thermal-expansion effect and no vacancy-trapping effect. (auth)

26774 HYPERFINE INTERACTIONS OF Sm IN $SmCo_5$. Streever, R. L. (Electronics Technology and Devices Lab., Fort Monmouth, NJ). Phys. Rev., B; 12: No. 11, 4653-4655 (1 Dec 1975).

The Sm magnetic hyperfine field in $SmCo_5$ was measured at 4.2°K using the NMR technique and is found to be 3.42×10^6 G. Effects on the hyperfine interactions and magnetic moment of the mixing of excited J-levels into the ground J equals ½ multiplet are found to be appreciable. (auth)

26775 MEAN-SQUARE DISPLACEMENTS OF (100) SURFACE ATOMS IN VANADIUM DETERMINED BY LOW-ENERGY ELECTRON DIFFRACTION. Cheng, D. J. (Univ. of California, Irvine); Wallis, R. F.; Megerle, C.; Somorjai, G. A. Phys. Rev., B; 12: No. 12, 5599-5607(15 Dec 1975).

The effective-surface Debye temperature for the (100) face of single-crystal vanadium has been measured as a function of incident electron energy in the energy range 0 to 400 eV using low-energy-electron diffraction. The ratio of surface-to-bulk atomic mean-square displacements has been estimated from the experimental data and has been investigated theoretically. A lattice-dynamical model consisting of central-potential interactions up to fourth neighbors together with harmonic angle-bending interactions is employed. The calculations have been performed using a set of special wave-vector points in the two-dimensional Brillouin zone which are the most efficient in finding the average of a periodic function over the Brillouin zone. Results have been obtained for both unchanged and changed force constants for the surface atoms. A comparison between the experimental and theoretical results is included. (auth)

26776 INFLUENCE OF UNOCCUPIED 5f-BAND STATES ON THE FERMI SURFACE OF Th METAL. Koelling, D. D.; Freeman, A. J. (Argonne National Lab., IL). Phys. Rev., B; 12: No. 12, 5622-5626(15 Dec 1975).

The influence of unoccupied 5f-band states on the Fermi surface of Th metal is determined by means of highly precise calculations of the Fermi-surface areas and effective masses. Comparison with experiment shows excellent agreement when the 5f electrons are treated as itinerant, unlike the predictions of the localized (f states removed) model. This result adds strong evidence for the itinerant nature of the occupied 5f states in the light actinides. (auth)

26777 MAGNETOELASTIC ULTRASONIC GENERATION TO $TbFe_2$ THIN FILMS. McLane, L. B.; Donoho, P. L.; Wimbush, W. L. pp 653-654 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (Ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

Ultrasonic elastic waves have been magnetostrictively generated at room temperature in polycrystalline films of $TbFe_2$ deposited on quartz and sapphire substrates at a frequency of 690 MHz. In the case of deposition at substrate temperature greater than 320°C, the films exhibited a strong magnetic anisotropy, with the easy axis invariably perpendicular to the plane of the film. This anisotropy leads to coercive forces as high as 6 kOe and remanent magnetizations as high as 80 percent of the saturation magnetization. The field dependence of the ultrasonic generation and the magnetic anisotropy were found to be strongly dependent on the film thickness and on certain deposition parameters, particularly the substrate temperature, as indicated. Annealing of the films subsequent to deposition also affected strongly the anisotropy and the ultrasonic generation efficiency. (Metals Abstr.)

26778 PHONON SPECTRA AND SUPERCONDUCTIVITY OF INDIUM–TIN ALLOYS. Moore, E. L. University Park, PA; Pennsylvania State Univ. (1975). 158p. University Microfilms Order No. 76-1370.

Thesis (Ph. D.).

An investigation was carried out of electron tunneling through an oxide barrier into a superconductor to study the lattice and superconducting properties of the four distinct substitutional phases of the In–Sn alloy system, in particular the phonon density of states. Measurements of the first derivative, dV/dI, and of the second harmonic voltage response, roughly d^2I/dV^2, across the superconducting aluminum/aluminum oxide/In–Sn junctions have been analyzed using the Eliashberg gap equations and the McMillan computer program. The product function alpha²(omega/sub q/) F(omega/sub q/), exhibiting the structure of the phonon density of states, has been determined for nine intermediate In–Sn compositions and redetermined for the two pure metals, In and Sn. Here F(omega/sub q/) is the phonon density of states and alpha² (omega/sub q/) is an electron–phonon coupling parameter which varies slowly with omega/sub q/. In the determination of the phonon spectra, the following normal state properties of In and Sn and their alloys have been computed: the Coulomb pseudopotential (mu*), the electron–phonon interaction strength (lambda), and an average phonon energy, [omega/sub q/]. These three normal state parameters were used to calculate the superconducting transition temperatures using the McMillan T/sub c/-equation. Transition temperatures computed in this research and transition temperatures determined by direct measurements in this research and in a previous investigation are compared. This comparison further demonstrates the validity of predicting the superconducting transition temperature from normal state parameters using the McMillan T/sub c/-equation. Determinations were also made of the energy gap parameter ($DELTA_0$) for the eleven compositions studied. (Diss. Abstr. Int., B)

26779 THERMAL CONDUCTIVITY OF HIGH PURITY VANADIUM. Jung, W. D. Ames, IA; Iowa State Univ. of Science and Tech. (1975). 109p. University Microfilms Order No. 76-1850.

Thesis (Ph. D.).

The thermal conductivity, Seebeck coefficient, and electrical resistivity of four high-purity vanadium samples were measured over the temperature range 5 to 300°K. The highest purity sample had a resistance ratio ($rho_{273}/rho_{4.2}$) of 1524. The highest purity sample had a thermal conductivity maximum of 920 W/mK at 9°K and had a thermal conductivity of 35 W/mK at room temperature. At low temperatures, the thermal resistivity was limited by the scattering of electrons by impurities and phonons. The thermal resistivity of vanadium departed from Matthiessen's rule at low temperatures. The electrical resistivity and Seebeck coefficient of high purity vanadium showed no anomalous behavior above 130°K. The intrinsic electrical resistivity at low temperatures was due primarily to interband scattering of electrons. The Seebeck coefficient was positive from 10 to 240°K and had a maximum which was dependent upon sample purity. (Diss. Abstr. Int., B)

26780 APPLICATION OF SOFT X-RAY APPEARANCE POTENTIAL SPECTROSCOPY TO LIGHT LANTHANIDES, 4D TRANSITION METALS, AND INSULATORS. Smith, R. J. Ames, IA; Iowa State Univ. of Science and Tech. (1975). 212p. University Microfilms Order No. 76-1873.

Thesis (Ph. D.).

Evaporated films of La, Ce, Yb, Y, Ag–Mn(5 percent), KCl, MnF_2, CsCl and LaF_3 were studied. Studies were also made of bulk polycrystalline samples of Y, Zr, Nb, and Mo. Results are discussed in terms of existing SXAPS theories. For Y, the $M_{4,5}$ and $M_{3,2}$ core excitations have similar intensities and line shapes. The importance of the transition matrix elements is discussed, and the spectra suggest that the Y 4d band maximum is 4 eV

above excitation threshold. The bulk samples of Y, Zr, Nb, and Mo give $M_{4,5}$ spectra which decrease in intensity with increasing Z. The Mn $L_{2,3}$ excitations in Ag–Mn (5 percent) were about 1.5 eV above the corresponding metallic Mn excitations and may result from excitations to the Mn local magnetic moment. For the rare earth metals, the spectra are interpreted in terms of the multiplet splitting. The principal difference between the La and Ce spectra is the presence of additional structure for La beyond that predicted by SXA. (Diss. Abstr. Int., B)

26781 SPECIFIC HEAT AND MAGNETIZATION OF THE SUPERCONDUCTORS: OSMIUM AND THE MONOXIDES OF NIOBIUM AND TITANIUM. Okaz, A. M. Lafayette, IN; Purdue Univ. (1975). 129p. University Microfilms Order No. 76-572. Thesis (Ph. D.).

The specific heat of a pure polycrystalline osmium sample (resistivity ratio 500) was measured between 0.18 and 4.2°K in zero magnetic field. The transition from superconducting to normal state occurs at T_0 equals 0.638 +- 0.002°K. In the normal state, the coefficient of the electronic contribution is 2.050 +- 0.003 mJ/mole K^2, and the Debye temperature at absolute zero, $THETA_0$ equals 467 +- 6°K. In the superconducting state, the electronic specific heat is in agreement with the relation C/sub es/ equals a gamma T_0e/sup -bT$_0$/T/ where a equals 9.8 and b equals 1.51. The critical field parameter H/sub c/(0) deduced from specific heat data is 77.5 gauss, and the maximum deviation of the critical field curve from the parabolic law is 4.3 percent. The value of the superconducting energy gap derived from gamma, T_0, and H/sub c/(0), is 3.55 k/sub B/T_0 and the gap is found to be nearly isotropic. The specific heat of five niobium monoxide (NbO /sub x/) samples of different compositions (x equals 0.96 to 1.02) was measured in the Meissner, mixed, and normal state. Niobium monoxide is found to be a weak coupling superconductor but the Meissner state parameters are in poor agreement with the BCS theory. NbO remains type II for all oxygen concentration, i.e., an intrinsic type II material. Magnetization data were taken for six different samples at two fixed temperatures. Specific heat results are given for seven titanium monoxide samples of compositions ranging from 0.91 to 1.17. The normal state results of all compositions are compared to previous theoretical and experimental work. From the coefficient of the electronic specific heat, the density of states at the Fermi surface are calculated for different compositions and compared to the band structure calculations. The superconducting state results of both $TiO_{1.06}$ and $TiO_{0.95}$ cannot be described by the BCS theory due to the broadness of the transition which might be a consequence of composition gradients within the sample. (Diss. Abstr. Int., B)

26782 ELECTRON SCATTERING STUDY OF CLEAN (100) TUNGSTEN AND ITS INTERACTION WITH OXYGEN AT LOW COVERAGES. Luscher, P. E. Chicago; Northwestern Univ. (1975). 282p. University Microfilms Order No. 75-29,700. Thesis (Ph. D.).

An electrostatic spectrometer was constructed to measure LEED, energy loss spectroscopy, Auger spectroscopy, electron stimulated desorption of ions, flash desorption, and incremental work functions in uhv vacuum. It is capable of operating over a wide range of incident electron beam energies (4 to 1800 eV) and spectral energies (0 to 1000 eV), and it provides charge/mass identification of desorbed ions through time-of-flight measurements. This spectrometer was applied to a study of the clean (100) surface of single-crystal tungsten and its interaction with oxygen at submonolayer coverages. Emphasis was placed on developing an understanding of the energy loss mechanisms in tungsten in order to obtain information on the electronic structure of the substrate and adsorbate. The loss spectrum of low energy (0 to 200 eV) electron scattering from W(100) was experimentally investigated and mechanisms giving rise to the fine structure analyzed using a dielectric response formalism. During adsorption of oxygen on W(100) at 300°K, sequential filling of two electronically inequivalent bonding states was observed. The oxygen in the second of these states is apparently more tightly bound, and its 2p orbitals may be split in energy into two separate levels. Heating of the oxygen dosed surface results in dramatic changes in the geometric structure. The nature of these changes is determined by both temperature and oxygen coverage. The energy distributions of the ions desorbed from the surface by the electron beam were examined. (Diss. Abstr. Int., B)

26783 INITIATION OF TYPE B SERRATIONS IN Cu–Be ALLOYS. Jovanovic, M. Scr. Metall.; 10: No. 2, 133-137 (Feb 1976).

The effects of temperature and strain rate on the critical strain at the onset of fine-type serrations in Cu–Be alloys were studied. Experimental results are presented showing that the serrations are activated and controlled by diffusing Be solute atoms. (JRD)

26784 PRECIPITATION OF In_2Bi FROM SUPERSATURATED INDIUM. Otto, G. H. (Univ. of Alabama, Huntsville). Scr. Metall.; 10: No. 2, 139-142 (Feb 1976).

The isothermal decomposition of supersaturated alpha-phase and its subsequent adjustment to compositional equilibrium in In–Bi alloys were investigated by resistivity measurements. Results show that the equilibrium state determined electrically is identical with the thermodynamic equilibrium in these alloys. (JRD)

26785 HIGH-TEMPERATURE CREEP MECHANISMS IN ALPHA-IRON AND AN Fe–Mo ALLOY DETERMINED BY STRESS-RLEAXATION TESTS. Oikawa, H.; Ichihashi, K.; Karashima, S. (Tohoku Univ., Sendai). Scr. Metall.; 10: No. 2, 143-146 (Feb 1976).

Rate controlling processes in high-temperature creep of alpha-iron and Fe–Mo alloys are described. Experimental results show that creep in Fe–Mo alloys is controlled by glide motions of dislocations which exert dragging forces on solute aggregates. High-temperature creep in alpha-iron is controlled by recovery processes in which the internal stress is reduced. (JRD)

26786 ELECTRICAL PROPERTIES OF AMORPHOUS Cu–Zr ALLOY. Murata, T.; Tomizawa, S.; Fukase, T.; Masumoto, T. (Tohoku Univ., Sendai). Scr. Metall.; 10: No. 2, 181-184 (Feb 1976).

The temperature dependence of electric conductivity and Hall effect in amorphous 60 percent Cu–40 percent Zr alloy was examined. It was found that the temperature coefficient of the resistivity is negative at temperatures below the crystallization temperature of 750°K, and the signs of the Hall coefficient and thermoelectric power are positive. (JRD)

26787 ZENER RELAXATION IN Fe–Be ALLOYS. Tanaka, K.; Okimori, H. (Nagoya Inst. of Tech., Showa, Japan). Scr. Metall.; 10: No. 2, 185-188 (Feb 1976).

Observations of the Zener relaxation peak in Fe-base Be alloys are reported. Features of the peak are discussed by comparing them with those of other ferrous alloy systems. Results show that an observed damping peak is associated with stress-induced diffusion of solute Be atoms in solid solutions i.e., the Zener relaxation peak. (JRD)

26788 CHEMICAL EXTRACTION OF REFRACTORY INCLUSIONS FROM IRON- AND NICKEL-BASE ALLOYS. Burke, K. E. (International Nickel Co., Inc., Suffern, NY). Metallography; 8: No. 6, 473-488 (Dec 1975).

Most iron- and nickel-base alloys contain certain refractory inclusions, which affect the physical properties of the alloy. Carbides are the predominant inclusion, but oxides, nitrides, sulfides, borides, and phosphides may also be present. A chemical extraction has been developed which effectively separates these inclusions from the matrix without the application of an external potential. The refractory inclusions are quantitatively extracted by chemical dissolution of the matrix at 25°C with a solution 0.9 M in copper(II) potassium chloride and hydrochloric acid. The reagent also contains 0.1 M tartaric acid to avoid contamination of the insoluble inclusion with matrix hydrolysis products. The chemical extractant is identified as the Berzelius reagent. The solvent is a general reagent for the isolation of most refractory phases: carbides, nitrides, phosphides, sulfides, oxides, and certain intermetallic compounds. The reagent dissolves alloys which are predominantly aluminum, cobalt, copper, iron, nickel, or zinc. The separation requires up to 24 hours to dissolve the alloys' matrix. (auth)

Radiation Effects

Refer also to abstracts 25474, 25492, 25498, 25566, 25892, and 28040.

26789 (AD/A-008337) COOPERATIVE RADIATION EFFECTS SIMULATION PROGRAM. Semiannual Progress Report, 1 May-31 Oct 1974. Steele, L. E.; Wolicki, E. A. (Naval Research Lab., Washington, D. C. (USA)). Mar 1975. 89p. (NRL-MR-2998). NTIS $4.75.

See also report dated Jul 1974, AD-784403.

This seventh semiannual progress report, covering the period 1 May-31 October 1974, includes progress in: (1) extension of the NRL energy deposition code to high velocity ion bombardments, (2) modification of the NRL energy deposition code to correctly account for range straggling, (3) extension of the Johnson–Gibbons range code to calculate the lateral range of a PKA, (4) an investigation of the effect of ion dose on void and dislocation structures in nickel at elevated temperatures, (5) studies of dose rate effects on void formation and growth in 2.8 MeV nickel-ion-irradiated nickel, (6) studies of the effects of dilute solute elements on the swelling of nickel during nickel ion bombardment, (7) an experiment to in-

vestigate irradiation-induced creep of reactor structural alloys by cyclotron bombardment, (8) the electronic control system for the irradiation-induced creep experiment, and (9) the data processing system for the irradiation-induced creep experiment. (GRA)

26790 (CEA-CONF-3149) IRRADIATION EFFECTS ON THE Ni ALLOYS USED IN REACTOR CORE STRUCTURES. Silvent, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 12 Jun 1975. 64p. (In French). INIS.

From 18th colloquium on metallurgy. Ni and its specific properties in certain types of alloys; Saclay, France (23 Jun 1975).

After a review of the radioinduced crystal defects in materials, the following radiation damages occurring in nickel alloys are analyzed: hardening, precipitation, swelling, creep, and embrittlement. All these damages are temperature dependent. Radiation hardening is particularly important at low temperature; irradiation creep appears at low temperature and swelling becomes only effective above 250°C. These effects disappear at 500-600°C. Irradiation embrittlement occurs only above this temperature. (FR)

26791 (CONF-751164-2) DEFECT PRODUCTION BY ENERGETIC PARTICLE BOMBARDMENT. Merkle, K. L. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 37p. Dep. NTIS $4.00.

From conference on radiation damage in metals; Cincinnati, Ohio, United States of America (USA) (9 Nov 1975).

Aspects of low-dose, low-temperature irradiation experiments, and elevated-temperature experiments are reviewed. Information and data are included on methods of determining lattice atom displacement thresholds, lattice damage rates measured by changes in resistivity, ion damage, and neutron damage. (JRD)

26792 (CONF-760209-10) CORRELATION BETWEEN BLISTER SKIN THICKNESS: THE MAXIMUM IN THE DAMAGE-ENERGY DISTRIBUTION, AND PROJECTED RANGES OF HELIUM IONS IN Nb FOR THE ENERGY RANGE 10 TO 1500 keV. St-Jacques, R. G.; Martel, J. G.; Terreault, B.; Veilleux, G.; Das, S. K.; Kaminsky, M.; Fenske, G. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 16p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

The skin thickness of blisters formed on polycrystalline niobium by $^4He^+$ irradiation at room temperature for energies from 15 to 80 keV have been measured. Similar measurements were conducted for 10 keV $^4He^+$ irradiation at 500°C to increase blister exfoliation, and thereby allow examination of a larger number of blister skins. For energies smaller than 100 keV the skin thicknesses are compared with the projected range and the damage-energy distributions constructed from moments interpolated from Winterbon's tabulated values. For energies of 10 and 15 keV the projected ranges and damage-energy distributions have also been computed with a Monte Carlo program. For energies larger than 100 keV the projected ranges of $^4He^+$ in Nb were calculated using either Brice's formalism or the one given by Schiott. The thicknesses for 60 and 80 keV, and those reported earlier for 100 to 1500 keV correlate well with calculated projected ranges. For energies lower than 60 keV the measured thicknesses are larger than the calculated ranges.

26793 (COO-2317-4) STUDY OF FERRITE FORMATION IN NEUTRON IRRADIATED AUSTENITIC STAINLESS STEELS. Progress Report, March 1, 1975-February 29, 1976. Stanley, J. T.; Hendrickson, L. E. (Arizona State Univ., Tempe (USA)). 1976. Contract AT(11-1)-2317. 21p. Dep. NTIS $3.50.

Magnetization measurements were carried out on a number of neutron-irradiated austenitic stainless steel specimens. Variation of magnetization with field indicates that the magnetic phase particles are very small so that the particles show superparamagnetic behavior. The temperature dependence of the magnetization indicates that more than one ferromagnetic phase may be present in some of the specimens. Postirradiation annealing at 500°C increased the quantity of magnetic phase in specimens that had been irradiated at 425°C and annealing in a magnetic field of 33 kOe has the effect of increasing the total quantity of magnetic phase but reducing the average size of the magnetic particles. (auth)

26794 (NTIS/PS-75/661) ION IMPLANTATION. A BIBLIOGRAPHY WITH ABSTRACTS. Search Period Covered: 1964-August 1975. Reimherr, G. (National Technical Information Service, Springfield, VA. (USA)). Aug 1975. 191p. NTIS $25.00.

Reports are cited which discuss research concerning ion implantation, particularly as applied to the microelectronics field. Specific topics include equipment, techniques, semiconductor doping, and radiation effects on material properties. 140 abstracts. (auth)

26795 EFFECT OF ADDITIONAL PLASTIFICATION OF IRRADIATED METAL WITH CURRENT PICKUP. Troitskii, O. A. (Inst. of Physical Chemistry, Moscow). Strength Mater. (USSR) (Engl. Transl.); 7: No. 1, 36-39(Jan 1975).

Translated from Probl. Prochnosti; 7: No. 1, 38-41(Jan 1975).

Radiation effects of electrons on Zn, Sn, In, and Pb crystals were investigated. It was found that under conditions of current pickup (short circuited circuit), when the concentration of free electrons in the metal is close to normal, the irradiated samples have a higher rate of creep than the samples deformed and irradiated without current pickup (open circuit), when the concentration of electrons is higher than normal. (auth)

26796 PENETRATION OF OXYGEN IN SOME WATER-IMMERSED, NEUTRON IRRADIATED METALS. Boissier-Chermette, M. (Centre d'Etudes Nucleaires de Grenoble, France); Ligeon, E.; Tousset, J. Radiat. Eff.; 26: No. 1-2, 71-77(Sep 1975).

An anomalous penetration of oxygen can be observed in certain neutron irradiated metallic samples. A strong oxygen diffusion occurs in niobium or iron but not in nickel, molybdenum, or platinum. This diffusion can only be observed when the samples are water immersed during neutron irradiation. Different initial concentrations of oxygen in the samples do not yield significantly different results. The surface state or the crystalline state of samples are of negligible importance. The oxidation products, the nature of the radiations and the penetration of hydrogen were also studied. (auth)

26797 VACANCY CREATION DURING LOW ENERGY ION BOMBARDMENT. Edwards, D.; Kornelsen, E. V. (National Research Council of Canada, Ottawa). Radiat. Eff.; 26: No. 3, 155-160(Oct 1975).

The use of a helium probe technique to determine the number of single vacancies in the damage state produced by ion bombardment is described. The technique is applied to (2 to 7) keV Ne on Ni(100) and to 5 keV Kr on W(100). In particular it is found that after a 5 keV Ne ion bombardment (8×10^{16}/cm^2) on Ni(100) there remains approximately 1 vacancy/ion in the damaged state whereas after a 5 keV Kr ion bombardment on W(100) there remains approximately (0.8 to 1.1) vacancies/ion. (auth)

26798 DAMAGE PRODUCTION BY FAST ELECTRONS IN DILUTE ALLOYS OF VANADIUM, NIOBIUM, AND MOLYBDENUM. Jung, P.; Lucki, G. (Kernforschungsanlage, Juelich GmbH, Ger.). Radiat. Eff.; 26: No. 1-2, 99-103(Sep 1975).

Vanadium, niobium, and molybdenum samples containing about 300 ppM of zirconium were irradiated at helium-temperature with electrons of energies between 0.6 and 3.1 MeV. The measured damage rates were analyzed in terms of minimum threshold energy, damage function, and resistivity per unit concentration of Frenkel pairs. For the minimum threshold energy T_d, values of 25 ± 2 eV (V), 28 ± 2 eV (Nb) and 34 ± 2 eV (Mo) were obtained. Pronounced differences between the displacement functions of molybdenum and that of niobium and vanadium are found which are explained by different stability of the defects during the irradiation at helium temperature. (auth)

26799 FORMATION OF HELICAL DISLOCATIONS IN PURE NIOBIUM SINGLE CRYSTALS UNDER ELECTRON IRRADIATION. Louchet, F.; Kubin, L. P. (Centre National de la Researche Scientifique, Toulouse). Radiat. Eff.; 26: No. 1-2, 67-69(Sep 1975).

Thin foils of niobium single crystals containing long screw dislocations with $b = a/2\langle 111\rangle$ have been irradiated at 900 keV in a high voltage electron microscope at room temperature. Climb of the dislocations under the electron beam lead to the formation of helical dislocations. In situ observations of their nucleation and growth are performed, and their nature is shown to be of interstitial type. (auth)

26800 SPATIAL DISTRIBUTION OF IONS IMPLANTED INTO SOLIDS SUBJECT TO DIFFUSION AND SURFACE SPUTTERING. Collins, R.; Carter, G. (Salford Univ., Eng.). Radiat. Eff.; No. 3, 181-191(Oct 1975).

The depth distributions of ions implanted into solids is evaluated theoretically for the situation where, following implantation and degradation to rest, each ion can diffuse in the solid while simultaneously the surface of the solid is eroded via the sputtering process. Time dependent and equilibrium solutions of the depth distribution or concentration profiles and the total quantities of trapped atoms are determined for cases where (a) the surface is a perfectly transparent boundary for diffusing ions, allowing immediate escape by diffusion only, and (b) the escape of diffusing ions takes place by surface erosion only, the diffusion rate be-

coming zero at the surface. Two methods of approach for situation (a) are examined – the Laplace transformation technique of the defining partial differential equation and a novel image method. Solutions are compared with earlier work and shown to correspond where appropriate. (auth)

26801 ANNEALING OF RADIATION DEFECTS BY PULSED LASER IRRADIATION. Kachurin, G. A.; Pridachin, N. B.; Smirnov, L. S. Fiz. Tekh. Poluprov.; 9: No. 7, 1428-1429(Jul 1975). (In Russian)

The effect of short ruby laser pulses on the properties of Si and GaAs crystals doped by the implantation of P and Te ions, respectively, was studied. The structural defects introduced by the ion implantation (radiation defects) were rapidly and completely annealed at very moderate temperature on applying the laser pulses. The process was almost instantaneous and led to the restoration of the original lattice, together with the electrical activation of the implanted impurity. The acceleration of annealing under laser irradiation was attributed to a reduction in the activation energy of defect displacement due to ionization. (Metals Abstr.)

26802 STAGE-I RECOVERY OF PREQUENCHED AND ELECTRON-IRRADIATED PURE ALUMINUM AND OF THE ALLOY Al-15 ppm Ag. Rizk, R.; Loreaux, Y.; Vajda, P.; Maury, F.; Lucasson, A.; Lucasson, P. (Equipe de Recherches du CNRS, Laboratoire de Chimie Physique, Bât. 350, F-91405 Orsay, France); Dimitrov, C.; Dimitrov, O. J. Appl. Phys. 47: No. 3, 809-816 (Mar 1976).

High-purity Al and the alloy Al-15 ppm Ag have been irradiated with electrons at liquid-helium temperatures. The influence of various parameters (electron energy and dose, impurity content and the presence of excess vacancies introduced by prequenching or irradiation doping) upon the annealing spectra of the radiation-induced residual electrical resistivity was determined. Besides the usually observed recovery substages in stage I (I_B, I_C, I_D, and I_E), we have found several supplementary structures labelled I_A (at 14–15 K), I_C' (at 26–27 K), I_D' (at 33 K), I_D^* (at 39 K), and I_F (between 53 and 59 K). The observed characteristics are compatible with the attribution of the substages I_A, I_B, I_C', and I_C to close-pair recombination; I_D', I_D, and I_D^* to correlated migration of interstitials; I_E to the recombination of freely migrating interstitials; and I_F to the migration of diinterstitials. (auth)

26803 THE PHYSICAL STATE OF IMPLANTED TUNGSTEN IN COPPER. Cullis, A.G.; Poate, J.M. (Bell Laboratories, Murray Hill, New Jersey 07974); Borders, J.A. Appl. Phys. Lett. 28: No. 6, 314-316 (15 Mar 1976).

The physical state of W implanted in Cu has been studied by $^4He^+$ ion channeling and transmission electron microscopy. At implant concentrations $\lesssim 1$ at.%, W is in solid solution but may form elemental bcc precipitates on annealing to $\gtrsim 450°C$. For implant concentrations of ~ 10 at.%, a disordered layer of Cu and W is formed with the W occupying no regular lattice sites; on annealing W precipitates are formed with dimensions of a few hundred angstroms. (auth)

26804 MASS SPECTROMETRY OF NEUTRAL MOLECULES SPUTTERED FROM POLYCRYSTALLINE METALS BY Ar^+ IONS OF 100-1,000 eV. Gerhard, W.; Oechsner, H. (Wuerzburg Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys., B; 22: No. 1, 41-48(1975).

6 figs.; 2 tabs.; 32 refs. Results of a thesis by W. Gerhard.

The flux of neutral particles sputtered from clean polycrystalline targets of 11 metals has been studied by mass spectrometry after being postionized in a low pressure hf plasma. Besides atoms Me_1, postionized metal mulecules Me_2 and Me_3 have been detected. The energy E_0 of the bombarding Ar^+ ions has been varied between 100 and 1,000 eV. Considering the different plasma influences, an attempt is made to obtain the initial composition of the beam of sputtered neutrals from the ratios R_{21} and R_{31} of postionized molecules Me_2 and Me_3 to postionized atoms, Me_1, respectively. The influence of the bombarding energy E_0 and R_{21} has been measured for all target elements, on R_{31} for Pd and Ag. The yields of Me_2 at $E_0 = 1$ keV approximately appear to be proportional to the square of the total sputtering yield S for the different target materials. This behavior and the energy dependence of R_{21} and R_{31} are discussed in view of a possible molecule formation process in sputtering. (DE)

26805 DISLOCATION LOOPS WITH $\alpha\langle 100\rangle$ BURGERS VECTOR PRODUCED BY 1 MeV ELECTRON IRRADIATION IN F.C.C. COPPER–NICKEL. Leffers, T.; Barlow, P. Philos. Mag.; 32: No. 2, 491-496(Aug 1975).

Dislocation loops with Burgers vector $\alpha\langle 100\rangle$ are formed in Cu–Ni alloys during 1-MeV electron irradiation in a high-voltage electron microscope at 350 to 400°C. The dislocation loops are of the interstitial type and pure edge in character with $\langle 110\rangle$ line vectors. Some dissociate into loops with Burgers vector $\alpha/2\langle 110\rangle$.

26806 VOID FORMATION DURING ANNEALING OF NEUTRON-IRRADIATED MOLYBDENUM. Petersen, K.; Evans, J. H.; Cotterill, R. M. J. Philos. Mag.; 32: No. 2, 427-430(Aug 1975).

Examination by transmission electron microscopy of Mo specimens neutron-irradiated at 60°C with doses of 2.16×10^{18} and 10.6×10^{18} fast neutrons/cm^2 has revealed the presence of voids with dia up to 60 Å. This observation corroborates earlier conclusions based on positron annihilation measurements.

26807 CHANGES IN POSITRON ANNIHILATION CHARACTERISTICS IN MOLYBDENUM INDUCED BY NEUTRON IRRADIATION. Petersen, K.; Knudsen, M.; Cotterill, R. M. J. Philos. Mag.; 32: No. 2, 417-426(Aug 1975).

Positron annihilation has been used in a study of the annealing of Mo samples irradiated at 60°C to doses of 2.16×10^{18} and 10.6×10^{18} fast neutrons/cm^2, and at 110°C to a dose at 2.11×10^{18} fast neutrons/cm^2. Isochronal annealing of these samples produced changes in the positron characteristics from which it was possible to identify the defect mechanisms involved in the different annealing stages and their dependence on irradiation conditions.

26808 COMBINED FIM [FIELD-ION MICROSCOPY], AES [AUGER ELECTRON SPECTROSCOPY], AND LEED STUDY OF THE STRUCTURE AND COMPOSITION OF ION-BOMBARDED TUNGSTEN SURFACES. Walls, J. M.; Martin, A. D.; Southworth, H. N. Surf. Sci.; 50: No. 2, 360-378(Jun 1975).

The results of various experimental techniques which have been used to gain information on the structure and chemical composition of W surfaces following low-energy ion bombardment with inert gases have been combined. A full description of the processes that occur is obtained and conclusions are made regarding the relative effectiveness of the different ion species in sputter-cleaning metal surfaces.

26809 REAL SOLIDS AND RADIATION. Hughes, A. E.; Pooley, D. London; Wykeham Publications (1975). 208p.

The subject is dealt with in chapters: the first two chapters form an introduction to the structure and properties of perfect solids; chapters 3 and 4 introduce the types of defect which may be present in a real solid; chapters 5 and 6 describe the interaction of solids with radiation, leading to a discussion of the production of defects by irradiation in chapter 7. Chapter 8 considers technological problems in radiation damage (fission and fusion reactors, solar cells, charge-trapping effects in devices (MOSFETs), phosphor degradation, lasers). Chapter 9 describes applications of radiation effects (solid-state radiation dosimetry, information storage devices, polymer impregnation of wood, ion implantation). (UK)

26810 RADIATION HARDENING AND VOID SWELLING OF NEUTRON IRRADIATED NIOBIUM (COLUMBIUM) AND NIOBIUM-1 PERCENT ZIRCONIUM ALLOY. Jang, H. I. Cincinnati; Univ. of Cincinnati (1975). 242p. University Microfilms Order No. 76-641.

Thesis (Ph.D.).

Nb and Nb–1 Zr irradiated to a fast neutron fluence of 1×10^{22} n cm^{-2} (E greater than 1 MeV) at 430, 580, 700, 800, 900, and 1050°C have been studied using transmission electron microscopy, microhardness, electrical resistivity, and bulk density change measurements. Voids are observed in as-irradiated Nb specimens at all six irradiation temperatures with the void size and concentration varying from 46 to 458 A and from 4×10^{16} to 1×10^{14} voids/cm^3, respectively. The resultant void swelling is 0.2 to 0.5 percent with a maximum swelling occurring at 1050°C. In Nb–1Zr the void swelling varies from 0 to 2 percent, and the maximum swelling occurs at the irradiation at 800°C. It has been demonstrated that a theoretical model on void swelling by Brailsford and Bullough fits reasonably well with the experimental data on Nb–1Zr, but it overestimates the swelling in Nb by a factor of up to approximately 10, especially at high irradiation temperatures. Void structures show little change during annealing up to 900°C, and completely anneal out thermally at or below 1400°C in most specimens. In addition to voids, other types of defect clusters, e.g., black spots, small dislocation loops, rafts, dislocations, and precipitates have been observed. These defects can serve as obstacles for dislocation movements, and consequently an increase in hardness occurs. Hardness contributions of these defects have been calculated and compared with measured Knoop microhardness data. The magnitude of radiation-hardening is 34 to 78 percent and 6 to 208 percent for Nb and Nb–1Zr, respectively. The minimum hardening occurs at 900 and 800°C in Nb and Nb–1Zr, respectively. The radiation hardening in Nb specimens irradiated at low temperatures is mainly due to the high concentration of voids, whereas that in Nb–1Zr specimens is due to black spots and small dislocation loops. The recovery of the radiation-hardening takes place at annealing temperatures be-

tween 800 and 1200°C with activation energies 2.23 to 2.35 eV for Nb and 1.77 to 1.94 eV for Nb-1Zr. (Diss. Abstr. Int., B)

26811 TEMPERATURE DEPENDENCE OF MAGNETIC ANISOTROPY INDUCED BY NEUTRON IRRADIATION IN Ni ALLOYS. Allia, P.; Soardo, G. P. pp 735-736 of Magnetism and Magnetic Materials. Graham, C. D. Jr. (ed.). New York; American Inst. of Physics (1975).

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974). See CONF-741202-.

It has been shown that only in some Fe alloys the temperature dependence of induced anisotropy energy K/sub u/ due to directional order of solute pairs fits the third power law of saturation magnetization I/sub S/(T) derived from theories of crystalline anisotropy energy. The first K/sub u/ vs T data are reported for NiCr 5 percent and NiPd 43 percent. Since T/sub c/'s are too low to permit atomic diffusion in the presence of a nonzero I/sub S/, directional order was obtained by fast neutron irradiation (1.3 x 10^{18} n/cm^2) under magnetic field (approximately 5000 Oe) at approximately 60°C. K/sub u/ measurements were performed by means of a sensitive torque balance between approximately 100 and 320°K. From the present preliminary results it is found that both in NiCr and in NiPd the K/sub u/ curves decay with increasing temperature faster than I^3/sub S/(T), approximately according to a I^6/sub S/(T) law, independently of the solute atom valency, which is 0 for Pd and 5 for Cr. (Metals Abstr.)

26812 DESIGN BASIS FOR CREEP OF ZIRCONIUM ALLOY COMPONENTS IN A FAST NEUTRON FLUX. Ross-Ross, P. A.; Fidleris, V. (Chalk River Nuclear Labs., Ont.). pp 216.1–216.7 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

The Chalk River Nuclear Laboratory's experience with the creep of zirconium alloys in a neutron flux is described. Fast neutron flux changes the creep behavior of zirconium alloys and new design criteria for in-reactor applications are needed. From experimental results empirical relations describing the effects of neutron flux, stress, temperature, time, and anisotropy on creep rate were established. The relations are applied to the design of pressure tubes. (auth)

26813 INFLUENCE OF SODIUM AND RADIATION ON THE CREEP AND FATIGUE OF FAST REACTOR COMPONENTS. Weeks, R. W.; Kassner, T. F.; Weins, J. J. (Argonne National Lab., IL). pp 229.1–229.8 of Creep and Fatigue in Elevated Temperature Applications. Volume I. New York; Mechanical Engineering Publications (1975).

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973). See CONF-730916-P1.

Information on the effects of Na and irradiation on creep-fatigue properties of austenitic stainless steels is reviewed. It is noted that the sodium coolant in a fast breeder reactor acts as a mass transfer agent, nominally carrying carbon and nitrogen from the hotter parts of the system to the cooler parts, causing decarburization/denitridization and carburization/nitridization of the components in the respective parts. Although there is a severe lack of data, it is evident that decarburization results in a reduction in tensile and creep strength, but with an increase in ductility that should increase low-cycle fatigue resistance. Carburization, of course, results in the opposite effects. Radiation tends to increase the tensile and creep strength of austenitic stainless steels, while the ductility decreases correspondingly. These property changes are consistent with a reduction in low-cycle fatigue life found in postirradiation testing. From the limited data available, it is obvious that the interaction of the effects of sodium and irradiation should be of major concern to reactor designers. The potential magnitude of the deterioration in mechanical properties of austenitic stainless steels exposed to such a reactor environment dictate that a much better understanding and quantification of these effects be obtained, particularly at high temperatures. In addition, considerable effort should be devoted to screening alternate alloys that have improved resistance to the reactor environment. The acute shortage of data in the areas of fatigue and creep-fatigue interactions of materials in a sodium environment results in a high degree of design uncertainty. It is anticipated that this circumstance will be resolved during the next few years; however, a greatly accelerated program might lead to a substantial return in terms of reduced design penalties. (auth)

26814 ENERGY DEPENDENCE OF THE DEFECT PRODUCTION AT 78 AND 400°K IN ELECTRON IRRADIATED COPPER. Roth, G.; Wollenberger, H.; Zeckau, C.; Luecke, K. (Kernforschungsanlage, Juelich, Ger.). Radiat. Eff.; 26: No. 3, 141-148 (Oct 1975).

Production rates of dislocation pinning points have been measured at 78 and 400°K in Cu irradiated with electrons of various energies between 0.25 and 2.8 MeV. At 78°K the energy dependence was found to coincide exactly with the energy dependence of resistivity damage rates. At 400°K a threshold energy for pinning point production of less than 8.5 eV was found. The interstitial displacement probability P(ϵ), however, is as small as 10^{-5} near this threshold. P(ϵ) rises into the order of magnitude of 10^{-2} at about 15 eV. Between 20 and 40 eV the 400°K displacement probability is slightly enhanced when compared with that at 78°K. The lowered threshold energy and the enhanced displacement probability is explained by a thermally activated escape from correlated recombination of those interstitials which belong to close pairs or which recombine spontaneously at 78°K or lower temperatures. (auth)

26815 INFLUENCE OF LOW-TEMPERATURE IRRADIATION ON THE PHASE COMPOSITION OF URANIUM ALLOYS CONTAINING SMALL QUANTITIES OF ALUMINUM AND IRON. Bobkov, Yu. V.; Naskidashvili, I. A.; Petrosyan, V. V.; Sokurskii, Yu. N. Sov. At. Energy (Engl. Transl.); 38: No. 1, 22-24(Jan 1975).

Translated from At. Energ. (USSR); 38: No. 1, 20-22(Jan 1975).

The changes taking place in the phase composition of dilute binary uranium alloys irradiated at −150°C were investigated. The electrical-resistance method was used to estimate these changes. It was found that with increasing dose the electrical resistance of the aged samples approaches the level corresponding to the quenched alloys. Extrapolation of curves shows that the electrical resistance of the aged alloys reaches the level of the quenched material for doses of ~1 × 10^{18} neutrons/cm^2. On this basis it may be assumed that for such doses the aged (heterogeneous) alloys pass into the homogeneous state. (auth)

26816 ATTEMPT OF DETECTING THE MIGRATION OF GOLD IN SILICON UNDER GAMMA IRRADIATION. Malkovich, R. Sh.; Nistiryuk, I. V.; Savin, E. P. Fiz. Tverd. Tela; 17: No. 8, 2415-2417(Aug 1975). (In Russian).

Existing data relating to the supposed migration of Au atoms in Si single crystals under the influence of γ-irradiation are discussed, and fresh attempts at detecting this effect are described. These attempts are based on a radioisotope method, and special measures are taken to eliminate any masking or interfering effects such as the decomposition of the solid solution because of the irradiation. No appreciable radiation-induced migration of Au was established, and it is concluded that the earlier data were erroneous. (Metals Abstr.)

26817 ENERGY LOSS OF 1000 keV ELECTRONS IN THIN SILICON CRYSTALS AS MEASURED BY HIGH VOLTAGE ELECTRON MICROSCOPY. Doi, K.; Izui, K.; Ohtsu, H.; Tomimitsu, H. (Japan Atomic Research Inst., Tokai). Radiat. Eff.; 26: No. 3, 129-133(Oct 1975).

Energy loss spectra of 1000 keV electrons transmitted by [111]-oriented thin silicon crystals were observed by an energy analyzer attached to the HVEM. The crystals were set to the systematic 220 Bragg reflection. Measurements were made for crystal thickness ranging from 1000 to 10,000 Å, which were determined by observations of pendellösung fringes. Results were analyzed using Landau's transport equation, giving the conclusion that the loss probability, which is the reciprocal of the mean free path, is 0.52 ± 0.02 × 10^{-3} Å^{-1} for plasmon excitation and 1.50 ± 0.02 × 10^{-3} Å^{-1} for L-electron excitation. (auth)

26818 DIRECTIONAL ARRANGEMENT OF DEFECT CLUSTERS IN ELECTRON-IRRADIATED COPPER. Yoshida, N.; Kiritani, M. J. Phys. Soc. Jpn.; 38: No. 4, 1220(Apr 1975).

A slightly deformed Cu specimen was irradiated with 2.0-MeV electrons at a flux of 4 × 10^{19} electrons/cm^2 · s at room temperature and observations were made simultaneously by means of a high-voltage electron microscope. A model is proposed to explain the mechanism by which ordered arrays of vacancy clusters are formed. (Metals Abstr.)

26819 GROWTH OF INTERSTITIAL-TYPE DISLOCATION LOOPS AND VACANCY MOBILITY IN ELECTRON-IRRADIATED METALS. Kiritani, M.; Yoshida, N.; Takata, H.; Maehara, Y. J. Phys. Soc. Jpn.; 38: No. 6, 1677-1686(Jun 1975).

Interstitial-type dislocation loops formed in Al, Au, Cu, Fe, and Mo by electron irradiation in a high-voltage electron microscope grow proportionally to a smaller power of the irradiation time than unity at lower temperatures under constant irradiation. At higher temperatures, when vacancies are mobile, the growth is linear with irradiation time. The balance between the product of the mobility and concentration of interstitials and vacancies ex-

plains the linear growth as well as the observed square-root dependence of the growth rate on the irradiation intensity. The temperature dependence of the growth rate can be used to obtain the migration activation energy of vacancies. Temperature-independent growth in a very thin specimen is due to the surface acting as a dominant sink for interstitial atoms. The efficiency of edge dislocations as sinks for interstitials and vacancies is discussed. (Metal Abstr.)

26820 EFFECT OF ELECTRON IRRADIATION ON THE PRECIPITATION OF IRON–NITROGEN ALLOY. Takeyama, T.; Takahashi, H. J. Phys. Soc. Jpn.; 38: No. 6, 1783(Jun 1975).

The interaction between a solute atom and a point defect in a Fe–0.03 wt.% N alloy as a result of irradiation by high-energy electrons in a high-voltage electron microscope was studied after subjecting the specimens to various heat treatments. (Metals Abstr.)

26821 INTERNAL FRICTION STUDIES ON REACTIONS OF CARBON AND NITROGEN WITH LATTICE DEFECTS IN NEUTRON IRRADIATED IRON. Weller, M.; Diehl, J. (Max-Planck Institut fuer Metallforschung, Stuttgart). Scr. Mettal.; 10: No. 2, 101-105(Feb 1976).

The annealing behavior of Snoek Peaks in neutron irradiated iron was studied. It was found that the appearance and disappearance of new internal friction peaks can be correlated with trapping and detrapping of interstitial foreign atoms (IFA) well enough to identify these peaks clearly with the relaxation of small complexes formed by trapping of IFA at radiation induced defects. (JRD)

26822 MECHANICAL PROPERTIES OF LOW TEMPERATURE PROTON IRRADIATED SINGLE CRYSTAL COPPER. Schildcrout, M. Pittsburgh; Univ. of Pittsburgh (1975). 105p. University Microfilms Order No. 76-372.

Thesis (Ph. D.).

Single crystal copper samples, of varying degrees of cold work, were irradiated near either liquid helium or liquid nitrogen temperature by 10.1-MeV protons. The internal friction and dynamic Young's modulus were observed as a function of either temperature or integrated proton flux. The primary effect of irradiation was to produce dislocation pinning. The initial pinning rate was found to be very sensitive to cold work. During irradiation it was found that heavily cold worked samples (25 percent compression) exhibited, almost exclusively, exponential pinning given by Y equals e/sup –lambda phi/. This is attributed to the immobilization, rather than shortening, of loop lengths and is characterized by the pinning constant lambda. Exponential pinning was also found, to a smaller degree, in less heavily cold worked samples. Cold work appears to reduce the "effective volume" within which the defect clusters, produced by irradiation, can immobilize dislocation segments. The bulk effect was observed after dislocation pinning was completed. Expressed in terms of the fractional change in Young's modulus per unit concentration of irradiation induced defects, it was measured at liquid helium temperature to be -18.5 ± 3. An anelastic process occurring near 10^0K for low kHz frequencies and due to stress-induced ordering of point defects produced by irradiation has also been studied. The peak height per unit fluence was found to decrease with increasing cold work. The peak was not observed in samples compressed 25 percent. For the most carefully handled sample the activation energy was $(1.28 \pm 0.05) \times 10^{-2}$ eV, the attempt frequency was 10/sup 11.6 +- .8/s^{-1}, the shape factor was 0.20, and the half width of the peak was 11 percent larger than the theoretical value calculated from the Debye equation for a single relaxation process. (Diss. Abstr. Int., B)

Other Materials

Refer also to abstracts 25496, 25734, 25876, 26422, 26466, 26504, 26573, 26575, 26588, 26594, 26614, 26615, 26618, 26637, 26780, 26801, 26911, 27983, and 28036.

26823 (AD/A-006017) ANALYSIS OF THE GROUND-TERM ENERGY LEVELS FOR TRIPLY IONIZED NEODYMIUM IN YTTRIUM ORTHOVANADATE. Technical Report. Wortman, D. E.; Karayianis, N.; Morrison, C. A. (Harry Diamond Labs., Washington, D. C. (USA)). Dec 1974. 18p. (HDL-TR-1685). NTIS $3.25.

An investigation has been made of the quartet I ground term of Nd(3+) in YVO_4. Wavelength and polarization measurements of the absorption in the wavelength range from 0.8 to 2.6 micrometers were used to establish energy levels for the quartet F($^3/_2$), quartet I($^9/_2$), quartet I($^{13}/_2$), and quartet I($^{15}/_2$) multiplets. These data were correlated with reported spectra in the literature, and an energy level scheme was obtained that identifies 25 out of the 26 ground term levels. Theoretical g(parallel) and g(perpendicular) values) are in good agreement with Ranon's reported values for the ground state; thus, the ground state symmetry property was determined to be γ (7,8) in S(4) notation or γ (7) in D(2a). (GRA)

26824 (AD/A-006465) INVESTIGATION OF ION IMPLANTATION AS A DOPING TECHNIQUE FOR THE III-V SEMICONDUCTORS AND TERNARY ALLOY SYSTEMS. Final Report, 1 Apr 1971-30 Jun 1974. Crowder, B. L. (IBM Watson Research Center, Yorktown Heights, N. Y. (USA)). 14 Feb 1975. Contract F44620-71-C-0040. 70p. NTIS $4.25.

The inadequacy of SiO_2 as a protective coating on GaAs for n-type implanted dopants was established. An investigation of alternative passivating layers was undertaken. Si_3N_4 was demonstrated to be effective as a protective coating and, when used in conjunction with elevated substrate temperatures during implantation, yielded n-type GaAs with a high doping efficiency for the implanted ions. Photoluminescence studies of Si-implanted GaAs indicated the existence of new species, presumably complexes between Si and damage induced point defects. Photoluminescence studies of Zn-implanted GaN demonstrated that ion damage is responsible for decreasing luminescence efficiency with increasing Zn dose for room temperature implantations and that higher efficiencies can be obtained by implantations at 300^{0}C. Preliminary results of ion implantation into AlN are presented. (GRA)

26825 (AD/A-006516) THE OCCURRENCE OF ANOMALOUSLY LOW FRICTION DURING ELECTRON BOMBARDMENT OF A SLIDING MOLYBDENUM DISULPHIDE SURFACE. Dukhovskoi, E. A.; Ponomarev, A. N.; Silin, A. A.; Talroze, V. L. Translated by G. H. Kinner from Zh. Eksp. Teor. Fiz.; 4: No. 20, 268-272(1974). 9p. (RAE-Lib-Trans-1829). NTIS $3.25.

Experimental data are given describing the occurrence of anomalously low friction when a sliding surface of molybdenum disulphide is irradiated with electrons. Indication is made of the mechanism and similarity of the effects when molybdenum disulfide is bombarded either by electrons or accelerated helium atoms. (GRA)

26826 (AD/A-006679) TRANSIENT RADIATION-EFFECTS TESTS OF A CORNING RADIATION-RESISTANCE OPTICAL FIBER. Physical Science Research Papers. Wall, J. A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 6 Jan 1975. 20p. (AFCRL-PSRP-622; AFCRL-TR-75-0012). NTIS $3.25.

Semi-transient and transient radiation-effects tests were performed on a Corning low-loss, radiation-resistant optical fiber. The semi-transient tests, which involved measurement of the fiber transmission during and after irradiation with x-rays, show this fiber to be much more resistant to permanent damage by radiation than other available glass fibers. The transient radiation-effects tests, in which the response of the fiber was measured during and for short times after pulses of x rays and neutrons, show that the fiber may not be applicable to systems that cannot tolerate operational lapses of a few microseconds duration. This is because the fiber emits fluorescent radiation and shows temporary transmission losses during and shortly after pulses of radiation. (GRA)

26827 (AD/A-007670) RADIATION INDUCED ELECTRICAL CURRENT AND VOLTAGE IN DIELECTRIC STRUCTURES. Physical Sciences Research Papers. Frederickson, A. R. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 22 Nov 1974. 41p. (AFCRL-TR-74-0582; AFCRL-PSRP-613). NTIS $3.75.

A computational technique has been developed in one dimension for prediction of radiation-induced electrical currents and electrostatic fields in metal-dielectric slab structures. High energy radiation transport effects produce divergent electron currents, time-dependent electrostatic fields, and time-dependent conduction electron currents. These effects are considered and the computational technique predicts electric fields approaching breakdown intensity and time-dependent electrode currents which may even change sign. Brief comments on application of the technique to field effect electronic devices are included. Results are given for several metal-dielectric slab combinations under 200 keV and 1.25 MeV photon irradiations. (GRA)

26828 (AD/A-008050) STUDY OF THE EFFECTS OF RADIATION ON THE ELECTRICAL AND OPTICAL PROPERTIES OF HgCdTe. Mallon, C. E.; Green, B. A.; Leadon, R. E.; Naber, J. A. (Intelcom Rad Tech, San Diego, Calif. (USA)). 31 Dec 1974. Contract F19628-72-C-0311. 52p. (INTEL-RT-8027-012). NTIS $4.25.

See also report dated 30 Jun 1974, AD/A-003390.

Results are presented of experimental and theoretical investigations of the effects of electron, neutron, and gamma irradiation on

the optical and electrical properties of the alloy semiconductor HgCdTe. These effects are of major interest in this program, since this data can be used to predict the radiation response of devices fabricated from HgCdTe. Section 2 discusses experimental methods used in this effort. The results of a 10K neutron irradiation of an n-type sample, QM 48-19, are presented. Changes in lifetime, carrier density, Hall mobility, and conductivity at 80K were studied as a function of electron energy between 2 and 30 MeV. Preirradiation temperature dependence measurements of carrier density, Hall mobility, conductivity, and steady-state photoconductivity of a p-type HgCdTe sample, QM 1, are presented. This sample was irradiated at 80K with 5-MeV electrons, which resulted in type conversion from p-type to n-type. The final section presents mobility and lifetime analysis and correlates the effects observed for neutron, gamma, and electron irradiations. (GRA)

26829 (AD/A-008177) THERMAL NEUTRON RADIATION EFFECTS IN II-VI COMPOUNDS. Final Technical Report, 1 Nov 1971-1 Nov 1973. Kikuchi, C.; Huang, C. (Michigan Univ., Ann Arbor (USA)). Nov 1974. Contract F33615-72-C-1189. 45p. NTIS $3.75.

The double acceptor center in neutron-irradiated CdTe was studied. The variation of resistivity as a function of time was measured. Analysis of experimental results suggests that (a) the double acceptor center includes Te-vacancy, (b) the height of the barrier is about 0.25 e (c) the effective range of the potential barrier is about 200 A and (d) the activation energy of motion of interstitial cadmium is estimated to be 0.74 eV. (GRA)

26830 (CEA-CONF-3164) PROCESS FOR FABRICATING MIXED-OXIDE POWDERS. Elmaleh, D.; Giraudel, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 1975. 7p. (In French). INIS.

From 4th European symposium for powder metallurgy; Grenoble, France (13 May 1975).

A physical-chemical process for fabricating homogeneous powders suitable for sintering is described. It can be applied to the synthesis of all mixed oxides having mutually compatible and water soluble salts. As a specific example, the fabrication of lead titanate-zirconate powders used to make hot pressed ceramics is described. These ceramics show improved piezoelectric properties. (FR)

26831 (CEA-N-1813) DIELECTRIC BREAKDOWN IN MONOMOLECULAR LAYERS. Barraud, A.; Rosilio, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Aug 1975. 20p. (In French). INIS.

The different phenomena encountered in the breakdown of very thin insultating films made of 1 to 9 Langmuir monomolecular layers are described. Three steps are observed in the breakdown process; bubble formation, sharp current increase, and the breakdown itself; a mechanism is proposed for each of these phenomena. Values of breakdown voltages and fields are given for monomolecular layers of various molecules between aluminium electrodes. The respective roles of the oxide and of the organic layers are discussed. (FR)

26832 (CONF-760209-8) INVESTIGATIONS OF RADIATIVE ELECTRON CAPTURE BY ION CHANNELING TECHNIQUES. Appleton, B. R.; Ritchie, R. H.; Biggerstaff, J. A.; Noggle, T. S.; Datz, S.; Moak, C. D.; Verbeek, H. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. 22p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

The unique constraints imposed on the interactions of energetic heavy ions as a result of the channeling effect are utilized to investigate the phenomenon of radiative electron capture (REC) for 17 to 40 MeV oxygen ions. Measured cross-sections and widths of the REC radiation are compared with calculations made specifically for the channeling situation.

26833 (JUL-1194) INVESTIGATIONS OF STRUCTURE AND TEXTURE DEPENDENT SURFACE REACTIONS BETWEEN PYROCARBON AND OXYGEN AT ROOM TEMPERATURE. Wolfrum, E. A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen; Technische Hochschule Aachen (F. R. Germany)). May 1975. 118p. (In German). INIS.

62 figs.; 17 tabs.; 102 refs.

Within the scope of general investigations on material properties of pyrocarbon coating layers on coated fuel particles, the chemical behavior of the pyrocarbon surface and the processes occurring on them in a reaction with oxygen or atmosphere at room temperature were investigated. The behavior of the reaction was studied as a function of surface properties of the solid and to develop, on the basis of these results, methods for a chemical characterization of pyrocarbon coating layers. The hydrogen peroxide concentration produced on the surface could be traced by fluorescence spectrometry in connection with the autoxidation reaction of N,N-dimethyl formamide. The concentration is proportional to the number of unpaired electrons of the pyrocarbon coating layers. The simultaneously produced basic surface oxides are a function of the disordered material of high inner surface. A method has been developed by which the concentration of the tangled material in pyrocarbon coating layers can be determined quantitatively. (DE)

26834 (JUL-1221) THE COAT-MIX-PROCESS. A New Process for the Production of Filler-Binder-Mixtures. Luhleich, H.; Dias, F.; Pflaum, P.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). Jul 1975. 27p. (In German). INIS.

14 figs.; 4 tabs.; 8 refs.

A new process is described for overcoating filler materials very homogeneously with phenol formaldehyde binders. In addition, pressureless molding processes developed for powders produced by the coat-mix-process are discussed. (DE)

26835 (KFA-IRE-IB-6/73) PROPERTIES OF CONCRETE AND ITS APPLICATION AS A REACTOR CONTAINMENT MATERIAL. Kroeger, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Mar 1973. 45p. (In German). INIS.

An introduction is given to the structure and to the most important properties of concrete that can be decisively influenced by the fresh concrete composition, the manufacture, post-treatment, and by operational conditions. Gas-tight concrete of great hardness can be obtained by following the given guidelines and this is then especially suitable as material for high-temperature reactor containments. The fresh concrete composition suggested for this use is compared to the British prestressed concrete pressure vessel. (DE)

26836 (KFK-2011, pp v) CERMETS IN PHASE DIAGRAMS. Ondracek, G.; Splichal, K. Mar 1975. (In German).

15 figs.; 1 tab.; 62 refs. Available from ZAED. Special prints from Ber. Dtsch. Keram. Ges. v. 48(8), 1971, p. 343-354.

In binary metal-ceramic phase diagrams and free formation enthalpies of ceramic and intermetallic compounds. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Nukleare Sicherheit).

The article is a review introduced by a more precise definition of cermets as ceramic-metal-composites. The reasons are given for subdividing these materials into stable and unstable combinations. A short remark is made about the calculation of the number of cermets, possibly formed in multicomponent systems. A systematic arrangement is presented of the more than 100 binary phase diagrams containing cermets known from the literature. As an example the calculation of a eutectic type phase diagram with a very narrow range of terminal solid solution is considered. Thermochemical assessments are also made to decide which stable combinations should be formed by interaction of the phases of unstable cerments using Fe_3C-U-cermets as an example. (DE)

26837 (KFK-2011, pp v) FREE ENTHALPIES OF FORMATION AND METAL-CERAMIC INTERACTIONS. Ondracek, G.; Wedemeyer, H. Mar 1975. (In German).

With figs.; 39 refs. Available from ZAED. Modified version from Sprechsaal Keram. Glas Email Silikattech. v. 108 (1975).

In binary metal-ceramic phase diagrams and free formation enthalpies of ceramic and intermetallic compounds. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Nukleare Sicherheit).

The free enthalpies of formation of ceramic and intermetallic compounds help to solve materials problems arising wherever reactions are possible between structural elements of materials or between different materials in contact with each other. This is the case, for instance, in nuclear safety research when an approximate estimation of the composition, and the properties, of a partly or completely melted reactor core has to be made. The temperature functions of the free enthalpies of formation were again compiled under this aspect, and supplementations were made where approximation equations could be deduced from experimental values in the relevant literature. The tables in this paper give about 500 of these temperature functions of the free enthalpies of formation. The general aim, i.e. the calculation of stable reaction products, is again stated, and the influence of the parameters of state pressure, temperature and concentration of the components is explained. (DE)

26838 (UCID-17021) DT FUSION NEUTRON IRRADIATION OF BNL-LASL SUPERCONDUCTOR WIRES, UW-LLL METALLIC FOILS, AND LLL COPPER TENSILE SPECIMENS. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore

Lab.). 3 Oct 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $3.50.

The irradiations were carried out in the LLL Rotating Target Neutron Source. The order of stacking of the specimens is given. Fluences for the dosimetry foils were calculated and are given. (DLC)

26839 NEW MATERIALS: A GROWING LIST OF NONMETALLIC METALS. Metz, W. D. Science; 190: 450-452(31 Oct 1975).

Research on TCNQ salts (one of which showed signs of superconductivity) and sulfur–nitrogen polymers, which did exhibit superconductivity, is reviewed. The structure of the (SN)/sub x/ polymers and their dimensionality are discussed. Applications of such one-dimensional conductors are likely to be in electronics or optics. (DLC)

26840 PHOSPHATES AND ARSENATES OF HEXAVALENT ACTINIDES. III. Ammonium–Americyl(VI)-Phosphate. Weigel, F.; Hoffmann, G. (Univ., Munich). J. Less-Common Met.; 44: 133-136(Jan 1976).

Ammonium-americyl(VI)-phosphate, $NH_4AmO_2PO_4 \cdot 3H_2O$, the first representative of a phosphate of hexavalent americium, has been prepared. The compound was found to be isomorphous with the compounds $NH_4UO_2PO_4 \cdot 3H_2O$ and $NH_4NpO_2PO_4 \cdot 3H_2O$. It crystallizes in a tetragonal lattice with a = 6.96 Å, and c = 9.03 Å. (auth)

26841 PHOSPHATES AND ARSENATES OF HEXAVALENT ACTINIDES. I. Uranium. Weigel, F.; Hoffmann, G. (Univ., Munich). J. Less-Common Met.; 44: 99-123(Jan 1976).

The compounds $M^{I}UO_2XO_4 \cdot yH_2O$, and $M^{II}(UO_2XO_4)_2 \cdot zH_2O$ (X = P, As; M^{I} = H, Li, Na, K, NH_4; M^{II} = Mg, Ca, Sr, Ba; y = 0...4; z = 0...11) have been prepared and systematically studied. The hydrogen compounds $HUO_2PO_4 \cdot 4H_2O$, and $HUO_2AsO_4 \cdot 4H_2O$ were grown as single crystals by diffusing solutions of $UO_2(NO_3)_2$, H_3PO_4, and H_3AsO_4, respectively, into large volumes of water. The alkali and alkaline-earth compounds were prepared by exchange of the H^+ ions in the hydrogen compounds for alkali- or alkaline-earth ions in $M^{I}Cl$ or $M^{II}Cl_2$ solutions, respectively. The hydrates formed by the various compounds were studied by thermal decomposition under constant H_2O partial pressure. The lattice constants of most compounds were obtained from powder data or—in some cases—single-crystal data and were compared with earlier measurements as far as such were available. (auth)

26842 LARGE DIAMETER CARBON–BORON FIBER. Veltri, R. D.; Galasso, J.; Galasso, F. S. (United Aircraft Corp., East Hartford, CT). Am. Ceram. Soc. Bull.; 54: No. 12, 1077-1078(Dec 1975).

From 76th annual meeting of the American Ceramic Society; Chicago, IL, USA (29 Apr 1974).

Deposition of B on C fibers was studied. It was found that large diameter carbon filament containing boron can be made with reasonable strength and modulus properties using the chemical vapor deposition process. The strength retention of these fibers at elevated temperatures was comparable if not slightly higher than the boron type fiber and resistance to attack by a 713 aluminum matrix was superior to that of presently available carbon yarn. (auth)

26843 TENSILE CREEP OF ANGLE-PILED BORON/EPOXY LAMINATES. Chwirut, D. J. (National Bureau of Standards, Washington, DC). J. Test. Eval.; 3: No. 6, 442-448(Nov 1975).

Tensile creep tests were performed at 75 and 300^{0}F on 26 specimens cut from +- 30-deg and +- 45-deg laminates of boron/epoxy composite material to characterize the creep behavior of these materials. A linear viscoelastic laminate theory proposed by McQuillen was compared with the experimental data for the tests run at 75^{0}F. The predicted creep strains differed greatly from the measured values, indicating that the linear theory is not applicable to laminates with these filament orientations. A general creep equation of the form epsilon equals k sigma/sup m/ t/sup n/ was fitted to the experimental data with excellent correlation. The stress exponents m varied from 1.79 to 5.17 for the four series of tests, thus characterizing the nonlinear behavior of boron/epoxy laminates with these filament orientations. 9 figures, 4 tables. (auth)

26844 PHOSPHATES AND ARSENATES OF HEXAVALENT ACTINIDES. II. Neptunium. Weigel, F.; Hoffmann, G. (Univ., Munich). J. Less-Common Met.; 44: 125-132(Jan 1976).

The compounds $M^{I}NpO_2XO_4 \cdot yH_2O$ and $M^{II}(NpO_2XO_4)_2 \cdot zH_2O$ (X = P, As; M^{I} = H, Li, Na, K, NH_4; M^{II} = Mg, Ca, Sr, Ba; y = 3–4; z = 6–10) have been prepared and identified by x-ray crystallographic comparison with the corresponding uranium compounds. The hydrogen compounds $HNpO_2$-$PO_4 \cdot 4H_2O$, and $HNpO_2AsO_4 \cdot 4H_2O$ were prepared by reacting an aqueous solution of $NpO_2(NO_3)_2$ with H_3PO_4 and H_3AsO_4 solutions, respectively. The ammonium-, alkali-, and alkaline-earth compounds were obtained by exchange of H^+ in the hydrogen compounds for the corresponding cations in chloride solutions. (auth)

26845 GYROTROPY OF CRYSTALS DUE TO VIBRONIC TRANSITIONS WITH ASYMMETRIC VIBRATIONS. Burkov, V.I.; Krasilov, Yu.I.; Kizel, V.A.; Madii, V.A.; Semin, G.S. Opt. Spectrosc. (USSR) 39: No. 4, 397-399 (Oct 1975).

The regions of dispersion and circular dichroism of weak vibronic bands corresponding to transitions with the participation of vibrations of an asymmetric type in the absorption spectra of sodium uranyl acetate $Na[UO_2(CH_3COO)_3]$, sodium uranyl deuteroacetate $Na[UO_2(CD_3COO)_3]$, cesium uranyl propionate $Cs[UO_2(C_2H_5COO)_3]$, and rubidium uranyl propionate $Rb[UO_2(C_2H_5COO)_3]$ are investigated experimentally. The presence of gyrotropy and circular dichroism is detected in all the crystals studied in the bands corresponding to vibronic transitions to vibrational states of uranyl with the symmetry e^*_{1u} ($\nu \sim 260$ cm^{-1}). The size of the rotational strength of these transitions is proportional to the degree of the decrease of the symmetry of the uranyl complex from D_{6h} to C_3. The observed behavior of the gyrotropy and circular dichroism is explained by the presence of a vibronic interaction and by a decrease of the symmetry to C_3 of the uranyl complex in the investigated crystals. (auth)

26846 GENERALIZED PHASE EQUILIBRIA OF GROUP VI-A ELEMENTS. Vezzoli, G. C. (Picatinny Arsenal, Dover, NJ); Doremus, L. W.; Walsh, P. J. Phys. Status Solidi (a); 32: No. 2, 683-693(16 Dec 1975).

The elements of group VI-A (O, S, Se, Te, and Po) display widely varying structures and properties at atmospheric conditions. However, these materials in both the solid and liquid phases show a general convergence to the metallic state with increasing pressure and temperature. The spectacular property changes from insulator to semiconductor to metal in the crystalline and liquid phases are due at least in part, to thermodynamic effects on the covalent bonding and can be consistently and accurately described by the development of normalized general structural diagrams which include related pressure-temperature and temperature-composition phase diagrams. The effects of increased pressure on the structure and properties can be analogued by altering composition from sulfur to selenium to tellurium. (auth)

26847 ANOMALOUS DIFFUSION OF HYDROGEN IN B-VH_x: PULSED-NMR EXPERIMENTS ON H^1. Kazama, S.; Fukai, Y. (Chuo Univ., Tokyo). Solid State Commun.; 17: No. 9, 1039-1041(1 Nov 1975).

Diffusion of hydrogen atoms in β-VH_x has been studied by means of a pulsed-NMR technique. A large temperature dependence of the activation energy towards the phase transition temperature β-α has been noted, and is interpreted in terms of a saddle point energy and the energy of stabilization of c-octahedral sites relative to other sites. (auth)

26848 DEEP TRAPS IN β-RHOBOHEDRAL BORON. Prudenziati, M.; Canali, C. (Univ., Modena, Italy). Phys. Status Solidi (a); 32: No. 2, 557-563(16 Dec 1975).

Activation energy of deep traps is studied in a series of β-rhombohedral boron samples taken by different companies and laboratories. It is found that the presence of deep traps in some samples induces polarization effects in transient photoconductivity experiments. The activation energy of these deep traps, determined by thermally-stimulated depolarization current measurements, is (0.45 ± 0.03) eV in agreement with results previously obtained using various techniques. The apparent absence of these deep traps in some samples shows that they are not associated with the complex lattice structure of β-rhombohedral boron. (auth)

26849 X-RAY MEASUREMENT OF THE THERMAL STRESS IN COMPOSITES. Takeda, H.; Morita, M. Zairyo; 24: No. 256, 35-40(Jan 1975). (In Japanese)

The thermal-stress behavior during the heating and cooling of composites was investigated by means of x-ray diffraction. The thermal stress of W/Cu composites did not vary linearly with temperature but produced a hysteresis loop. The loop is related to the matrix stress/strain behavior at high temperature. (Metals Abstr.)

26850 MICROSTRUCTURAL CHANGES OCCURRING IN COMPOSITE MATERIALS DUE TO CYCLIC THERMAL TREATMENT. Chawla, K. K. Microstruct. Sci.; 2: 115-128(1974).

Composites consisting of a high-purity Cu matrix containing W fibers were subjected to cyclic thermal treatment. The thermal stresses generated were accommodated by the soft matrix. Slip lines appeared due to plastic deformation in the matrix at low temperature. The extent of slip deformation was a function of the relative misorientation between the matrix grains. Unlike in the low-fiber volume fraction (Vf) composites, no slip line density gradient was observed in these high-Vf composites. This was thought to be due to the overlap of the stress fields of various

unit composites (a fiber and its associated matrix shell constituting a unit composite) in the present high-Vf composites. At high temperature extensive grain boundary migration occurred which alleviated the stress acting across it. This grain boundary recovery process left the area swept by it capable of undergoing further deformation on subsequent cycling which served to delay the onset of grain boundary cavitation and sliding and thus suppressed the intercrystalline cracking. (Metals Abstr.)

26851 INTERACTION OF THERMAL AND RADIATION DEFECTS IN SILICON. Panov, V. I.; Smirnov, L. S.; Tishkovskii, E. G. Fiz. Tekh. Poluprov.; 9: No. 8, 1580-1583(Aug 1975). (In Russian)

The manner in which radiation-induced defects build up in Si single crystals subjected to electron bombardment after preliminary heat treatment of the samples at 440°C (giving rise to thermally-induced defects) was studied. The rate of introduction of electrically-active defects and A centers into the samples containing thermally-induced defects increased in proportion to the concentration of the thermal donors. On the basis of experimental results a semi-empirical mechanism is proposed for the processes involved in the interaction between thermally and radiation-induced defects. Analogous effects may occur during the hot irradiation of Si crystals even without preliminary heat treatment. (Metals Abstr.)

26852 EFFECT OF γ RADIATION ON THE DISLOCATION CHARGE IN LiF. Bielig, G. A. (James Cook Univ. of North Queensland, Townsville, Australia). Philos. Mag.; 32: No. 5, 1075-1077(Nov 1975).

A bent single crystal of LiF was mounted on a Marx composite resonator and exposed to γ radiation at room temperature. The signal developed across the specimen faces by the vibrating dislocations was monitored together with the decrement and elastic modulus. It was found that the magnitude of the dislocation line charge decreased with radiation time, the rate being governed by the amount of deformation applied to the specimen prior to irradiation. (auth)

26853 DYNAMICS OF REPLACEMENT SEQUENCES AND OF CROWDIONS. Dienes, G. J. (Brookhaven National Lab., Upton, NY); Smoluchowski, R. J. Phys. Chem. Solids; 37: No. 1, 95-98(1976).

The theory of the formation of point defects by ionization in alkali halides has been extended to include the dynamics of the subsequent motion of replacement sequences and of crowdions (H-centers) at low temperatures. Particular attention is paid to the stochastic aspect of the motion of these centers, which appears to play a crucial role in interpreting recent experimental studies of interaction processes of H-centers with other defects in alkali halides. It turns out that at not too low temperatures the rate controlling reaction is the rotation of the centers. A detailed analysis of the kinetics of the various competing processes is given. (auth)

26854 GETTERING OF BORON BY AN ION-IMPLANTED ANTIMONY LAYER IN SILICON. Fair, R. B.; Pappas, P. N. (Bell Telephone Labs., Inc., Allentown, PA). Solid-State Electron.; 18: No. 12, 1131-1134(Dec 1975).

Secondary ion mass spectrometry has been employed to reveal the gettering of implanted B by an annealed, implanted Sb layer. It is shown that the gettering of B is significant, and may be caused by electric-field-enhanced diffusion of the B as well as by solubility enhancement of the electrically active Sb. These results emphasize the first-order importance of cooperative effects between donors and acceptors in diffusion profile calculations. (auth)

26855 LATTICE LOCATION AND IONIZATION INDUCED ANNEALING OF SELF-INTERSTITIALS IN BORON-IMPLANTED SILICON BY RUTHERFORD BACKSCATTERING. Goetz, G.; Sommer, G. (Jena Univ., Ger.). Phys. Status Solidi (a); 32: K151-K154(16 Dec 1975).

Implantation of 150 kV ^{11}B ions was carried out at 70°K on B-doped Si. Measurements of Rutherford backscattering and radiation damage from 1.4 MV He ions were made. Results show that the ionization stimulated annealing due to He^+ ions is strongly coupled to a low damage level and reduced homogeneous nucleation of radiation damage during the implantation. Either the annealing defects themselves are self-interstitials or other point defects, which recombine with self-interstitials. By comparing the backscattering spectra it is indicated that heterogeneous nucleation results in unambiguous peaks of back-scattered ions in the depth of maximum damage and more homogeneous nucleation of damage centres in strong dechanneling only. Heterogeneous nucleation indicates more intrinsic defects, which are thermally annealed in the region of 100 to 150°C for boron implantation at 78°K. Because this is in the region of self-interstitial annealing, it is concluded that the defects, which are annealed due to the He^+ beam, are self-interstitials, too. (auth)

26856 EXPLANATION OF RADIATION DAMAGE IN SELENIUM SINGLE CRYSTALS. Johansson, J. (Technical Research Centre of Finland, Espoo); Tiainen, O. J. A.; Valkiainen, M. Phys. Status Solidi (a); 32: No. 2, K105-K107(16 Dec 1975).

The resistivity of Se under irradiation at 80°K was measured. The resistivity changes versus fast neutron fluence is presented graphically and compared with calculated values. An equation for calculating the density of radiation-induced scattering centers and their dependence on fast neutron fluence is given. (JRD)

26857 LOW-TEMPERATURE OPTICAL PROPERTIES OF X-IRRADIATED RbCl AND RbBr CRYSTALS. Riggin, M.; Radhakrishna, S.; Whippey, P. W. (Univ. of Western Ontario, London). Phys. Status Solidi (a); 32: No. 2, 711-716(16 Dec 1975).

The thermoluminescence from single crystals of RbCl and RbBr irradiated with x-rays at 10°K were correlated with optical absorption spectra, recorded between 5 and 273°K, of similarly damaged crystals. Trapping parameters of TL glow curves ascribed to H and V_k centers were estimated from analysis of the experimental results. (auth)

26858 EMPIRICAL DETERMINATION OF THE RANDOM FRACTION IN DISORDERED CHANNEL. Matsunami, N.; Itoh, N. (Nagoya Univ., Japan). Radiat. Eff.; 26: No. 3, 173-176(Oct 1975).

A new method of deriving the random fraction in a disordered channel from dechanneling experiments is described. Using this method, backscattering spectra obtained at two different doses are employed, with an assumption on the dose dependence of the defect concentration. The method is applied to the experimental data for B-implanted Si and it is found that the random fraction found is similar to the result obtained using the diffusion calculation. The depth profiles of defects are also obtained and compared with the result of theoretical calculations. (auth)

26859 ELECTRICAL ACTIVATION PROCESSES OF P^+ IONS CHANNELED ALONG THE [110] AXIS OF SILICON. Effect of Annealing on Carriers Profiles Shape. Cembali, F.; Galloni, R.; Zignani, F. (Consiglio Nazionale delle Ricerche, Bologna). Radiat. Eff.; 26: No. 3, 161-171(Oct 1975).

Phosphorus ions at energies of 100, 200, and 300 keV and doses between 5×10^{14} and 5×10^{15} at.cm^2 have been implanted into silicon crystals along the [110] axis. Electrical carriers distributions have been determined by means of differential sheet resistivity and Hall-effect together with the anodic oxidation stripping technique. Isochronal recovery of the number of carriers/cm^2 has also been performed, in the temperature range 25 to 900°C. Rutherford backscattering analysis has been used to determine the radiation damage distributions produced by the implanted atoms; 300 keV proton back-scattering spectra as a function of annealing temperature has also given information on the damage recovery processes. The shape of carriers profiles, as a function of annealing temperature between 100 and 900°C, has been compared with the damage distribution due to the implantation itself and correlation between phosphorus electrical activation and damage has been shown. It seems possible to single out three different regions in the carriers depth distributions with different mechanisms of phosphorus electrical activation. In the region beneath the surface, where the damage distribution is peaked, the larger fraction of phosphorus atoms becomes electrically active, going into substitutional sites during the amorphous zones recrystallization at temperatures below 550 to 600°C. In the region 0.3 to 0.4 μm thick near the maximum range reached only by well channeled ions, P^+ becomes electrically active approximately between 125 and 175°C. This process is tentatively attributed to the migration of E-centers already formed at room temperature. In the intermediate region phosphorus becomes active in the temperature range 375 to 575°C. (auth)

26860 OBSERVATION BY SCANNING ELECTRON MICROSCOPY OF RADIATION DAMAGE PRODUCED IN LiF BY IONIC BOMBARDMENTS. Morin, P.; Vicario, E.; Davenas, J.; Perez, A.; Thevenard, P.; Dupuy, C. H. S. (Lyon Univ., Villeurbanne, France). Radiat. Eff.; 26: No. 3, 149-154(Oct 1975).

A scanning electron microscope supplied with a discharge system for insulating materials has been used to observe LiF crystals bombarded with 2 MeV protons, 60 MeV oxygen ions, and 56 MeV chlorine ions. The damaged zone gives a clear contrast which allows a direct measure of the penetration depth of the incident ions. This contrast has been attributed to the defects which were also revealed by means of optical absorption measurements. The bleaching of defects during thermal annealings allows the observation of the stopping zone of the incident ions. In this case, the observed contrast is due to the variation of the mean atomic number in the implanted zone. This permits a direct measure of straggling. For light implanted ions (2 MeV protons) the contrast of the stopping zone can be attributed to an escape

of fluorine atoms from this heavily damaged zone. For heavy implanted ions (56 MeV chlorine ions) the chemical contrast is due to the implanted ions themselves. (auth)

26861 THERMOLUMINESCENCE OF X-RAY DAMAGED NH 4Cl CRYSTALS. Riggin, M.; Radhakrishna, S.; Whippey, P. W. (Univ. of Western Ontario, London). Solid State Commun.; 17: No. 10, 1301-1304(15 Nov 1975).

A relatively intense thermoluminescence peak has been observed at about 245°K in x-irradiated NH_4Cl crystals. This peak is correlated with the optical absorption properties of the crystals and is ascribed to thermal destruction of V_k centers. Various models of the thermoluminescence processes are compared with experimental glow curves, and the parameters giving the best fit to experimental results are reported. (auth)

26862 LUMINESCENCE INDUCED BY X-RAYS IN LITHIUM HYDRIDE. Ikeya, M. (Yamaguchi Univ., Japan). Solid State Commun.; 17: No. 10, 1233-1235(15 Nov 1975).

Luminescence spectra and decay times of a single crystal LiH were measured using x-ray and pulsed electron excitation at low temperature. The emission band at 4.4 eV with a decay time of 220 ns and the one at 3.3 eV with decay times of 17 and 150 μs are tentatively ascribed to correspond to the σ- and π-type transitions, respectively, of the $(X_2^- + e)$ in alkali halides. (auth)

26863 POLARIZED LUMINESCENCE OF F_A^+ CENTERS IN CALCIUM OXIDE. Hughes, A. E.; Pells, G. P. (UKAEA Research Group, Harwell, Eng.). J. Phys., C (London); 8: No. 21, 3703-3709(7 Nov 1975).

Studies of the polarization of luminescence from F_A^+ centers in CaO have been carried out to confirm the presence and position of the second absorption band of this center, the F_{A2}^+ band. It has been shown that there is polarization in the F_{A1}^+ luminescence band of the center when excited at 325 nm, consistent with the presence of an A → E absorption transition in this region. Complete polarized excitation spectra show that this F_{A2}^+ absorption band peaks at 332 nm, confirming the earlier assignment by Boas et al. (J. Phys. C: Solid St. Phys.; 6:1639(1973)). A new emission band peaking at 430 nm has been found in Mg-doped CaO crystals, which is shown to be an A → A transition at a defect of tetragonal symmetry. The center has an A → A absorption band at 406 nm and an A → E absorption band at 317 nm, and it is proposed that the defect is an F_{AA}^+ center: an F^+ center perturbed by two neighboring Mg impurities. (auth)

26864 STUDY OF U_2 CENTERS IN BaClF AND SrClF CRYSTALS. Yuste, M. (Paris Univ., Orsay, France); Lefrant, S.; Spaeth, J. M.; Taurel, L. J. Phys., C (London); 8: No. 21, 3491-3498(7 Nov 1975).

X-irradiation, at T = 78°K, of SrClF crystals containing OH^- ions leads to the formation of $U_2(H_I^0)$ centers. These centers are thermally stable up to T = 140°K. The magnetic properties and thermal stability of the U_2 center are compared with those of the U_2 center observed in BaClF crystals. Calculation of the hyperfine and superhyperfine parameters of the U_2 center was performed on the basis of a Hartree-Fock approximation, including a covalent bonding between the hydrogen atom and its nearest chlorine ions. The experimental and theoretical results obtained in BaClF and SrClF are compared to those of the U_2 center in RbCl, KCl and NaCl and it is concluded that the distance between the hydrogen atom and the nearest chlorine ions plays the most important role. (auth)

26865 *INVESTIGATION OF THE DEFECT PROFILES IN ION-IRRADIATED AND ANNEALED SILICON BY THE CONDUCTION ELECTRON ESR METHOD.* Gerasimenko, N.N.; Glazman, V.B.; Dvurechenskii, A.V. (Institute of Semiconductor Physics, Siberian Division, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.—Semicond. 9: No. 9, 1139-1142 (Sept 1975).

An investigation was made of the change in the line width $\Delta H_{pp}(x)$ of the ESR signal of conduction electrons during layer-by-layer etching of ion-irradiated and annealed (700–1150°C) silicon layers. The observed dependence $\Delta H_{pp}(x)$ was found to be related to the distribution of defects with depth in the investigated layers. The defect profiles were calculated. These profiles had, depending on the irradiation conditions and nature of the ion, either one or two maxima: 1) in the region of the projection of the range R_P of the implanted phosphorus ions; 2) near the surface. An analysis of the results obtained indicated that the first maximum was associated with defects which included phosphorus atoms that did not occupy regular sites. The surface-damage layer was attributed to interstitial defects. (auth)

26866 ACCUMULATION OF ELECTRICALLY ACTIVE CENTERS IN *n*-TYPE SILICON DUE TO ELECTRON AND LIGHT-ION BOMBARDMENT. Bulgakov, Yu.V.; Kolomenskaya, T.I.; Kuznetsov, N.V.; Shemaev, B.V. (M. V. Lomonosov State University, Moscow). Sov. Phys.—Semicond. 9: No. 9, 1185-1186 (Sept 1975).

Silicon samples with an identical *P* concentration but different *O* concentrations were irradiated with 1 MeV electrons and 6.3 MeV/nucleon ions of H, D, and He. The accumulation of the principal radiation defects was investigated. (AIP)

26867 INJECTION-STIMULATED DISLOCATION MOTION IN SEMICONDUCTORS. Kimerling, L.C.; Petroff, P.; Leamy, H.J. (Bell Laboratories, Murray Hill, New Jersey 07974). Appl. Phys. Lett. 28: No. 6, 297-300 (15 Mar 1976).

Misfit dislocations introduced during LPE growth are shown to act as sinks for point defects introduced by 1-MeV electron bombardment in $Ga_{1-x}Al_xAs_{1-y}P_y/GaAs$ p^+n heterojunctions. Electron-beam-stimulated dislocation motion was observed directly with *in situ* TEM studies on previously bombarded material. SEM measurements have correlated beam-induced defect annealing with recombination-enhanced defect motion. These results suggest that dislocation networks, which are active in the dark-line-defect degradation mode of heterostructure lasers, may form by a climb mechanism which is activated by the injection-stimulated motion of point defects. (auth)

26868 DIRECT OBSERVATIONS OF DEFECTS IN IMPLANTED AND POSTANNEALED SILICON WAFERS. Glowinski, L.D.; Tu, K.N.; Ho, P.S. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Appl. Phys. Lett. 28: No. 6, 312-313 (15 Mar 1976).

We have used transmission electron microscopy to study crystalline defects in Si wafers which were first implanted with Si ions to produce an amorphous surface layer and then annealed to produce epitaxial regrowth. The original high degree of crystalline perfection is not ehtirely recovered. In the implanted layer, small defect clusters, interstitial loops, and large half-loops have been observed. The density, distribution, and characteristics of these defects have been determined. (auth)

26869 RADIATION-INDUCED EFFECTS IN GaAs THIN-FILM OPTICAL (10.6 μm) WAVEGUIDES. Share, S.; Epstein, A.S. (Harry Diamond Laboratories, Adelphi, Maryland 20783); Monse, T.; Chang, W.S.C.; Chang, M.S. Appl. Phys. Lett. 28: No. 6, 340-342 (15 Mar 1976).

Two types of GaAs thin-film optical waveguide structures operating at 10.6 μm were examined before and after exposure to neutron and γ irradiation. The attenuation rate of the $GaAs/n^+$-GaAs structure was particularly sensitive to neutron irradiation of 10^{13} cm^{-2} and exhibited postirradiation annealing at 150°C. This is in contrast to the relative neutron irradiation insensitivity of a $GaAs/GaAs_{1-x}P_x/n^+$-GaAs structure. The effect of γ radiation is less pronounced for both structures. The radiation-induced changes are discussed in terms of free-carrier absorption, index of refraction, scattering centers, and absorption by complexes. (auth)

26870 BOMBARDMENT-ENHANCED DIFFUSION OF ARSENIC IN SILICON. Maby, E.W. (RCA Laboratories, Princeton, New Jersey 08540). J. Appl. Phys. 47: No. 3, 830-836 (Mar 1976).

A theoretical model which describes a diffusion process enhanced by ion bombardment has been investigated for the case of arsenic in silicon. The model predicts a spatially variant diffusion coefficient of the form $D^*f(x,L_d)$, where L_d is an unknown constant characteristic of the diffusing medium and presumably independent of the diffusing species. An experimental value for L_d was determined which agrees well with the theory, but differs from the value obtained for boron in silicon. (auth)

26871 TSC STUDIES OF CARRIER TRAPPING IN ELECTRON- AND γ-IRRADIATED TEFLON. Gross, B.; Sessler, G.M.; West, J.E. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Appl. Phys. 47: No. 3, 968-975 (Mar 1976).

A study of thermally stimulated current (TSC) spectra of 25-μm Teflon samples preirradiated with 40–75-keV electron beams or ^{60}Co γ rays is presented. The currents, obtained under an applied or an internal field, are genefally due to a superposition of drifts of primary injected and secondary radiation-generated carriers. The TSC spectra are identical for both kinds of irradiation if comparable dose rate and total dose are used and if no excess charge is present. In general, two current peaks at about 70 and 200°C, respectively, are observed. The low-temperature peak is sensitive to storage conditions; it furthermore saturates with applied field and increases with radiation dose. The high-temperature peak shows no significant dependence on storage conditions, and does not saturate as easily with applied field, but tends toward earlier dose saturation. (auth)

26872 DISSOCIATION OF MgO FILMS UNDER HEAT AND ELECTRON BOMBARDMENT AND ITS EFFECTS ON SECONDARY EMISSION. Dresner, J.; Goldstein, B. (RCA Laboratories, Princeton, New Jersey 08540). J. Appl. Phys. 47: No. 3, 1038-1043 (Mar 1976).

The dissociation of MgO films under heat and bombardment by 1000-eV electrons has been measured in line of sight with a quadrupole mass analyzer. The samples were prepared by oxidizing Mg films in O^{18}. In

the range $230 < T < 500$°C, the thermal dissociation is noncongruent, the yield $Y_O > Y_{M_g}$. Electron bombardment strongly increases Y_{M_g} but has no effect on Y_O; Y_{M_g} is quadratic in the current density j and saturates at a value close to Y_O. Both atoms were detected as neutral species; Mg is evolved solely as the monomer, and oxygen is evolved mainly as the monomer, with $Y_{O^+} : Y_{O^{++}} \simeq 10$. A model in which the evaporation rates of Mg and O are independently limited by charge transfer at the surface of the insulator is proposed. It accounts for our results as well as the dependence $Y_O \propto j^2$ reported by other investigators, and correctly predicts the dependence on primary energy $Y(E_p) \propto j^2 E_p^{2.7}$. The secondary emission δ of cleaned films of MgO is insensitive to prolonged electron bombardment at 0.1 A/cm^2. The application of heat alone *in vacuo* causes changes in δ which have been correlated with changes in surface stoichiometry. (auth)

26873 METHOD FOR PREPARING BORON-CARBIDE ARTICLES. Benton, S. T.; Masters, D. R. (to U. S. Energy Research and Development Administration). US Patent 3,914,371. F27B9/04; C04B3522; C01B31/36; C04B35/60. 21 Oct 1975. Filed date 27 Dec 1973. 4p.

PAT-APPL-428,927.

The invention is directed to the preparation of boron carbide articles of various configurations. A stoichiometric mixture of particulate boron and carbon is confined in a suitable mold, heated to a temperature in the range of about 1250 to 1500^{0}C for effecting a solid state diffusion reaction between the boron and carbon for forming the boron carbide (B_4C), and thereafter the resulting boron-carbide particles are hot-pressed at a temperature in the range of about 1800 to 2200^{0}C and a pressure in the range of about 1000 to 4000 psi for densifying and sintering the boron carbide into the desired article.

26874 METHOD AND APPARATUS FOR FABRICATING A COMPOSITE STRUCTURE CONSISTING OF A FILAMENTARY MATERIAL IN A METAL MATRIX. Banker, J. G.; Anderson, R. C. (to U. S. Energy Research and Development Administration). US Patent 3,913,657. B22D19/02; B22D23/00; B22D27/16. 21 Oct 1975. Filed date 17 Jul 1974. 8p.

PAT-APPL-489,215.

A method and apparatus are provided for preparing a composite structure consisting of filamentary material within a metal matrix. The method is practiced by the steps of confining the metal for forming the matrix in a first chamber, heating the confined metal to a temperature adequate to effect melting thereof, introducing a stream of inert gas into the chamber for pressurizing the atmosphere in the chamber to a pressure greater than atmospheric pressure, confining the filamentary material in a second chamber, heating the confined filamentary material to a temperature less than the melting temperature of the metal, evacuating the second chamber to provide an atmosphere therein at a pressure, placing the second chamber in registry with the first chamber to provide for the forced flow of the molten metal into the second chamber to effect infiltration of the filamentary material with the molten metal, and thereafter cooling the metal infiltrated-filamentary material to form said composite structure.

26875 APPARATUS FOR FABRICATING COMPOSITE CERAMIC MEMBERS. Roy, P.; Simpson, J. L.; Aitken, E. A. (to U. S. Energy Research and Development Administration). US Patent 3,915,119. C23C13/12. 28 Oct 1975. Filed date 7 May 1974. 6p.

PAT-APPL-467,684.

Methods and apparatus for fabrication of composite ceramic members having particular application for measuring oxygen activities in liquid sodium are described. The method involves the simultaneous deposition of ThO_2: 15 percent Y_2O_3 on a sintered stabilized zirconia member by decomposition of gaseous $ThCl_4$ and YCl_3 and by reacting with oxygen gas. Means are provided for establishing an electrical potential gradient across the zirconia member whereby oxygen ions, from a source on one side of the member portion to be coated, are migrated to the opposite side where a reaction and said decomposition and deposition are effected.

26876 TWO PHOTON ABSORPTION IN $Zn_xCd_{1-x}Te$ SINGLE CRYSTALS. Baltramiejunas, R.; Gavriusin, V.; Vaitkus, J.; Andronik, I.; Lukyan, F. (Kapsukas State Univ., Vilna). Phys. Status Solidi (a); 31: No. 2, K159-K163(16 Oct 1975).

The two photon absorption coefficient in $Zn_xCd_{1-x}Te$ ($O \leq x \leq 1$) single crystals was investigated. A two-step transition sequence was found to occur in this compound. Data on the spectral dependence of two photon absorption coefficient at 300°K in this compound are presented in a chart. (JRD)

26877 COMPOSITE MATERIALS BY INFILTRATION OF SILICON NITRIDE. Leimer, G.; Gugel, E. (Annawerk G.m.b.H., Roedental (F. R. Germany). Bereich Ceranox). Z. Metallkd.; 66: No. 10, 570-576(Oct 1975). (In German)

10 figs.; 6 tabs.; 24 refs.

Based on the works of R. Kieffer an attempt was made to densify the porous reaction-sintered silicon nitride by means of infiltration. Tests with silicon nitride powder compacts were conducted previously for the purpose of studying the effects of additions. Infiltration only succeeded with so-called deoxidation alloys, which react with silicon nitride. There are formed polifphase composites due to the presence of reacting products. As some of the reacting products possess refractory properties, these materials are also of interest for technological applications. The best composites are presented, their phases and structures described and the mechanical properties reported. (DE)

26878 STEEL FIBRE REINFORCED CONCRETE-PRODUCTION, PROPERTIES AND POSSIBILITY OF APPLICATION FOR BUILDINGS OF NUCLEAR POWER PLANTS. Schnuetgen, B. (Bochum Univ. (F. R. Germany). Inst. fuer Konstruktiven Ingenieurbau). Konstr. Ingenieurbau Ber.; No. 23, 104-110(1975). (In German). (AED-CONF-75-491-010).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 7 figs.; 6 refs.

The report gives information on steel fiber reinforced concrete studies carried out at the Ruhr-University Bochum in the Institute of Structural Engineering. The reinforcement of concrete with randomly distributed short length steel wire increases the tensile strength and the resistance against dynamic loads of concrete. The thermal conductivity increases whereas the shrinkage value of concrete decreases. These properties allow the conclusion that steel fiber reinforced concrete is a material applicable for the construction of nuclear power plants especially for reactor buildings and prestressed concrete reactor vessels. (DE)

26879 A NUCLEAR CHEMICAL METHOD FOR THE INVESTIGATION OF ARGON, KRYPTON, AND XENON DIFFUSION IN GLASSES AND VITREOUS SILICA. Felix, F. W. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kernchemie und Reaktor). Glastech. Ber.; 48: No. 10, 213-215(Oct 1975). (In German)

3 figs.; 4 tabs.; 9 refs.

Radioactive argon, krypton and xenon have been produced by a nuclear chemical method in glasses containing potassium and uranium, and in silica containing uranium. The ordinary glass samples were then degassed between 400 and 700°C and the vitreous silica between 1,150 and 1,700°C. The activation enthalpies for gas diffusion in the ordinary glasses were found to be: argon 1.7 eV, krypton 1.9 eV, xenon 3.3 eV. In silica the release by diffusion was below the limits of measurement. By extrapolation it was shown that D_{Kr} is approximately $D_{Xe} \leq 10^{-14}$ cm^2 s^{-1} at the transformation point. (DE)

26880 INVESTIGATIONS ON THE ADSORPTION OF IODINE ON VARIOUS PIPE MATERIALS. Hiller, S.; Schad, H. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Reaktortechnik). Kerntechnik; 17: No. 7, 320-323(Jul 1975). (In English, German)

1 fig.; 1 tab.; 2 refs.

In monitoring the exhaust air from nuclear power stations it is not always possible to avoid long pipework lines between the stack and the measuring station. It cannot, therefore, be excluded that radioactive constituents of the exhaust air may become adsorbed on the wall of the piping and thus escape measurement. *The adsorption affinity of various pipework materials for iodine* is reported. The findings show that teflon and polyethylene are more favorable in this respect than steel and PVC. Adsorption *can be reduced still further by electric shielding of the plastic* pipes to prevent electrostatic charging. (DE)

26881 SOME THERMAL PROPERTY MEASUREMENTS ON UO_2-Mo COMPOSITES. *Gilchrist, K. E.; Brocklehurst, J. E.;* Ware, J. O. (UKAEA Reactor Group, Springfields). Rev. Int. Hautes Temp. Refract.; 12: No. 2, 146-152(Apr 1975).

From 4th European Conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

Measurements of thermal diffusivity and thermal expansion coefficient have been performed in the temperature range 20-1,350°C on compacted pellets of UO_2-Mo cermets manufactured at RFL Springfields. Thermal conductivity data derived from these results show that at high temperatures there is a significant improvement over the thermal conductivity of UO_2. At low temperatures the results are qualitatively consistent with the generation of porosity at particle/matrix interfaces by differential thermal contraction between the two phases. This porosity complicates the analysis, and appears to have a marked effect out of proportion to its volume because of the way it is distributed, tending to isolate the UO_2 from contributing to conduction. For molybdenum contents less than 10% the results show that the matrix is becoming less continuous and the thermal conductivity tends towards that for UO_2. This conclusion is supported by metallographic

examination. The more limited thermal expansion data support the above picture with a major contribution from UO_2 at high temperatures, and at low temperatures a negligible contribution from UO_2 when the molybdenum content is 12% but a significant contribution from UO_2 when the Mo content is 6% and the matrix becomes less continuous. (FR)

26882 ASSESSMENT OF THERMAL STRESSES IN BORON FIBERS. Polyakov, V. A.; Zhigun, I. G. (Inst. of Polymer Mechanics, Riga). Strength Mater. (USSR) (Engl. Transl.); 7: No. 3, 349-354(Mar 1975).

Translated from Probl. Prochnosti; 7: No. 3, 85-89(Mar 1975).

A theoretical study was made of thermal stresses in B fibers in order to determine the causes of cracking in the fibers. The fibers are represented as a system consisting of two infinite coaxial cylinders made from different materials. Unsteady cooling is considered. 24 equations (DLC)

26883 RADIATION DEFECTS IN p-TYPE SILICON IRRADIATED WITH 14-MeV NEUTRONS. Isaev, N. U.; Karsybaev, M. Sh. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 76-78(1974). (In Russian).

The radiation defects in p-type Si after irradiation with 14-MeV neutrons and high-temperature annealing were studied. Defects were detected with the levels E_c −0.16 eV, E_v + 0.55 eV, and E_v + 0.30 eV, and in zone Si at E_v + 0.21 eV, E_v + 0.30 eV, E_v + 0.45 eV, and E_v + 55 eV. It was shown that in the process of isochronous annealing the acceptor levels E_v + 0.35 eV and E_v + 0.12 eV appear and are annealed. They belong to defects with a complex structure. (tr-auth)

26884 MEASUREMENTS OF HEAT CAPACITY, ELECTRICAL RESISTIVITY AND HEMISPHERICAL TOTAL EMITTANCE OF TWO GRADES OF GRAPHITE IN THE RANGE 1,500 TO 3,000°K BY A PULSE HEATING TECHNIQUE. Cezairliyan, A.; Righini, F. (National Bureau of Standards, Washington, D. C. (USA)). Rev. Int. Hautes Temp. Refract.; 12: No. 2, 124-131(Apr 1975).

From 4th European Conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

Measurements of heat capacity, electrical resistivity and hemispherical total emittance of Poco and pyrolytic graphites in the temperature range 1,500 to 3,000°K by a subsecond duration pulse heating technique are described. For a given graphite grade, heat capacities of different specimens were in agreement within 0.5 percent. The difference between the results of the two different grades was about 1.8 percent: the results of Poco being higher than those of pyrolytic. Electrical resistivity of the Poco graphite was about four times greater than that of pyrolytic graphite (parallel to basal planes). Hemispherical total emittance of Poco graphite was almost twice that of pyrolytic graphite. (FR)

26885 FOURIER TRANSFORM INFRARED STUDY OF THE EFFECTS OF IRRADIATION ON POLYETHYLENE. Tabb, D. L.; Sevcik, J. J.; Koenig, J. L. (Case Western Reserve Univ., Cleveland). J. Polym. Sci., Polym. Phys. Ed.; 13: 815-824(1975).

Fourier transform infrared spectra were obtained for polyethylene gamma-irradiated in oxygen and nitrogen atmospheres. The spectra before and after irradiation were compared by digital subtraction. The difference spectra are indicative of changes caused by irradiation. Crosslinking and chain scission reactions produce the observed changes. (auth)

26886 MORPHOLOGY OF GAMMA-IRRADIATED, LOW-DENSITY, BULK POLYETHYLENE. Besmann, T.; Greer, R. (Iowa State Univ., Ames). J. Polym. Sci., Polym. Phys. Ed.; 13: 527-532(1975).

Low-density bulk polyethylene was subjected to gamma radiation doses between 0.1 and 100 megarads. Surfaces produced by fracture at liquid nitrogen temperatures were studied using scanning electron microscopy. The unirradiated polyethylene and polymer irradiated to 0.1 megarad had spherical units with a diameter of about 0.15 micron lying on the fracture surface. The units lay along the edges of the lamellae and were formed by the fracture that was, therefore, not entirely brittle. Polyethylene irradiated between 1 megarad and 100 megarads exhibited spherical voids, with a diameter of about 0.1 micron in the fracture surface. The voids have been produced either by the evolution of gas in the polymer during irradiation, the most likely mechanism, or as a function of the fracture mechanism only. (auth)

26887 MATRIX ENDOR OF POLYENYL RADICALS IN POLYMERS. Helbert, J. N. (Army Electronics Tech. and Devices Lab., Fort Monmouth, NJ); Wagner, B. E.; Poindexter, E. H.; Kevan, L. J. Polym. Sci., Polym. Phys. Ed.; 13: 825-834(1975).

EPR and matrix ENDOR spectra were examined for polyenyl radicals in gamma-irradiated PVF, PVF_2, PVC, and PMMA polymers. Proton matrix ENDOR is observed for all four polymers, and fluorine matrix ENDOR for PVF and PVF_2. By line shape analysis of the ENDOR spectra obtained under comparable conditions, delocalization diameters for the unpaired electron of the polyenyl radical in each polymer are obtained. These diameters indicate extensive delocalization over 5 to 7 carbon double bonds for the polyenyl radicals investigated. It is suggested that these conjugated and crosslinked radiation products account for the observed nondevelopment of electron beam resist PMMA material at high radiation charge densities. (auth)

26888 RADIATION CONDUCTIVITY OF ALKALI-HALIDE CRYSTALS. Annenkov, Yu. M.; Pichugin, V. V. (Tomsk Polytechnic Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 147-149(1975). (In Russian).

The facts accumulated on the radiation conductivity of alkali halide crystals are analyzed. The effect of defects accumulated during radiation on the main characteristics of radiation conductivity are explained for alkali halide crystals. From experimental data on the radiation conductivity as a function of temperature and chemical composition of the crystals, and from the efficiencies of electron-hole recombination processes with participating of radiation defects as determined by the methods of absorption spectroscopy and luminescence analysis, it is possible to conclude that the "flare" effect and subsequent decrease of radiation conductivity are associated with the generation of radiation defects with the formation of F-centers playing the main role. A comparison of the kinetics of F-center accumulation with the kinetics of radiation conductivity shows that the energy levels of the generated F-centers play the role of adherence levels for nonequilibrium charge carriers. (SJR)

26889 RADIATION GENERATION OF CATION VACANCIES IN NaBr AT A TEMPERATURE OF 130°K. Annenkov, Yu. M.; Frangul'yan, T. S.; Galanov, Yu. I. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 131-132(1975). (In Russian).

The radiation change in ionic conductivity of NaBr crystals which were given an x-ray dose of ~10^6 rads at 130°C was investigated. At this temperature the ionic vacancies are practically immobile. The experimental results show that the electrical conductivity of NaBr samples irradiated at 130°K is almost an order of magnitude higher than in unirradiated samples. These data indicate that there is an increase in the number of cation vacancies even under conditions of low-temperature irradiation. (SJR)

26890 STRUCTURES OF FLUORIDES. XIII. The Orthorhombic Form of Tungsten Hexafluoride at 193°K by Neutron Diffraction. Levy, J. H.; Taylor, J. C.; Wilson, P. W. (Australian Atomic Energy Commission, Sutherland). J. Solid State Chem.; 15: No. 4, 360-365(Dec 1975).

The positional parameters in the orthorhombic phase of solid tungsten hexafluoride WF_6, have been determined by total profile analysis of a neutron powder pattern taken at 193°K. WF_6 at 193°K is orthorhombic, with space group Pnma(D^{16}/sub 2h/) and a equals 9.603(3), b equals 8.713(4), and c equals 5.044(3) A at 193°K. The full matrix, least-squares refinement converged at R equals SIGMA (parallel y_0 - (1/c)y/sub c/parallel)/SIGMA y_0 equals 0.075 where c is the scale factor and y_0 is one of the 306 background-corrected intensities in range of one or more Bragg reflections along the pattern. The refinement showed that, at this temperature, WF_6 has the orthorhombic UF_6 structure. The mean W−F distance is 1.81 A, and the mean F−F separation between octahedra is 3.12 A. The results are compared with previous neutron profile studies of the orthorhombic phases of UF_6 and MoF_6 at 193°K, and with a neutron profile Kubic Harmonic analysis of the cubic form of WF_6 at 266°K. On the basis of these structural studies in this series of hexafluorides, reasons are given why MoF_6 and WF_6 have a high-temperature cubic phase, but UF_6 does not. Deviations from idealized hcp coordinates in the orthorhombic phases are in a direction such that the fluorine atoms become strongly bonded to the metal atoms to form a molecular, rather than an ionic, lattice.

26891 MOESSBAUER STUDIES ON ^{83}Kr AFTEREFFECTS IN SOLID KRYPTON. Kolk, B. (Rijksuniversiteit, Groningen, Netherlands). Phys. Rev., B; 12: No. 11, 4695-4701(1 Dec 1975).

Moessbauer investigations on ^{83}Kr in solid krypton at 4.2°K show that the recoilless fraction of a solid-krypton source is about 40 percent lower than that of a solid-krypton absorber. This effect is attributed to aftereffects caused by the highly converted 32-keV gamma-ray decay which precedes the recoilless gamma-ray transition. (auth)

26892 DEFECTS IN IRRADIATED SILICON: EPR AND ELECTRON-NUCLEAR DOUBLE RESONANCE OF INTERSTITIAL BORON. Watkins, G. D. (General Electric Corporate Research and Development, Schenectady, NY). Phys. Rev., B; 12: No. 12, 5824-5839(15 Dec 1975).

An EPR spectrum, labeled Si-G28, is identified as arising from

neutral interstitial boron in silicon. It is produced by 1.5-MeV electron irradiation at 20.4°K, presumably when a substitutional boron atom traps a mobile interstitial silicon atom which is produced in the original damage event. Three possible models are discussed which are consistent with the EPR and electron-nuclear double-resonance results: (a) a bent Si–B–Si bonded interstitialcy; (b) a similar Si–Si–B interstitialcy; or (c) a Jahn–Teller distortion of the boron from the hexagonal interstitial site in the silicon lattice. Uniaxial stress in the presence of light at low temperatures produces alignment in one of the distortional degrees of freedom for the defect. This is interpreted as stress alteration of the capture matrix elements for electrons into the differently distorted configurations. Polarized light is also found to produce alignment in the absence of stress into a second degree of freedom of the defect. Thermally activated recovery from this alignment reveals an activation energy for reorientation of 0.6 eV. Interstitial boron is unstable at room temperature, disappearing in approximately 30 min with an activation energy also of approximately 0.6 eV. It is suggested that annealing may result from long-range migration of the interstitial boron with the one-jump diffusional process being identical to the 0.6-eV reorientational process. This is a natural consequence of models (a) or (c). The reorientation stimulated by light at 4.2°K, therefore, indicates that athermal migration may be induced by the light. An attempt to test this using 1.06-mu m YAlG:Nd laser illumination was inconclusive. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

26893 (AED-CONF-74-725-000 (Vol. 2), pp 701-717) OPTIMIZATION OF WASTE MANAGEMENT IN THE EG WITH THE AID OF SYSTEMS ANALYSIS METHODS. Braun, H. W. M.; Ditterich, K.; Schneider, J. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The problems of waste management range from their production when they must be collected to transport, conditioning, etc., and, finally, to safe disposal. Until recently, the subsystems in waste management had for the most part been treated empirically and separately. In this paper, all subsystems are considered and related to each other with systems analysis methods. In this way the complex problem including the initial and end values can be optimized with regard to a maximum of security and reliability and a minimum of cost and environmental load. The annex contains a simplified example for the treatment of waste management by methods of systems analysis. (DE)

26894 NATIONAL DEBATE ON THE HANDLING OF RADIOACTIVE WASTES FROM NUCLEAR POWER PLANTS. Lash, T. R.; Bryson, J. E.; Cotton, R. Palo Alto, CA; Natural Resources Defense Council, Inc. (1974). 54p. Natural Resources Defense Council, Inc., 664 Hamilton Avenue, Palo Alto, CA, 94301, $1.50.

The following aspects of radioactive wastes from nuclear power plants are discussed: generation of radioactive wastes and the health hazards posed by radioactivity; radioactive waste management programs, plans, and alternatives, U. S. experience with radioactive waste management, and citizen action. (LK)

26895 METHOD FOR UTILIZING DECAY HEAT FROM RADIOACTIVE NUCLEAR WASTES. Busey, H. M. (to U. S. Energy Research and Development Administration). US Patent 3,911,684. F03G7/00. 14 Oct 1974. Filed date 29 Aug 1974. 4p.

PAT-APPL-501,726.

Management of radioactive heat-producing waste material while safely utilizing the heat thereof is accomplished by encapsulating the wastes after a cooling period, transporting the capsules to a facility including a plurality of vertically disposed storage tubes, lowering the capsules as they arrive at the facility into the storage tubes, cooling the storage tubes by circulating a gas thereover, employing the so heated gas to obtain an economically beneficial result, and continually adding waste capsules to the facility as they arrive thereat over a substantial period of time.

Accountability and Safeguards

Refer also to abstracts 26038, 26098, and 28199.

26896 NUCLEAR SAFEGUARDS. Taylor, T. B. (International Research and Technology Corp., Arlington, VA). Annu. Rev. Nucl. Sci.; 25: 407-421(1975).

An overview is given of the risks of destructive uses of nuclear materials and of the actions that are being taken or could be taken to reduce these risks. Emphasis is on basic facts and issues that are likely to be relevant for some time. A definition of safeguards is offered. Resources that would be needed by subversives to make fission explosives are discussed. International civilian nuclear technology is reviewed and power and Pu production by each country tabulated. Finally, present and possible future safeguards are discussed. (DLC)

Disposal and Storage

Refer also to abstracts 25542, 25543, 25560, 25996, and 26880.

26897 (AED-CONF-74-725-000 (Vol. 2), pp 444-467) EXPERIENCE FROM THE REGISTRATION AND EVALUATION OF RADIOACTIVE MATERIALS EMITTED WITH THE WASTE WATER FROM NUCLEAR POWER STATIONS IN THE FRG. Aurand, K.; Arndt, J.; Gans, I.; Ruehle, H.; Wolter, R. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The emission system EMIS provides for the monitoring and documentation of all types and quantities of radioactive materials emitted in the waste water of nuclear power stations. It can also be modified to fit the radioactive materials emitted in the waste air. The design of EMIS enables reviews and evaluations from special points of view for all registered radionuclides and other data to be made at any time. These selective evaluations for individual regions or catchment-basins of rivers are a prerequisite for the early detection of possible accumulations of different nuclides and for the optimization of radioecological studies. The system can be extended to other sources of emission such as users of unsealed radionuclides in research, medicine, and engineering as soon as the necessary administrative steps have been taken. It will then be possible to record the total environmental load resulting from the emission of radioactive substances and to make a comprehensive evaluation of it. (DE)

26898 (AED-CONF-74-725-000 (Vol. 2), pp 719-735) DISPOSAL OF RADIOACTIVE WASTES. Breest, H. C. 1974. (In German).

From annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F. R. Germany (23 Sep 1974).

Available from ZAED.

In radiation protection and environmental protection. Vol. 2. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (F. R. Germany); Vereinigung Deutscher Strahlenschutzaerzte e.V., Muenchen (F. R. Germany)).

The paper deals with the management of radioactive wastes from nuclear engineering; the systematic disposal of radioactive materials from isotope application in scientific technology and medicine is only mentioned in passing. The chief stress of the discussion is on the requirements of radiation protection and the ensuing regulatory measures. The present methods and development trends in the conditioning of radioactive wastes are discussed starting with the different kinds of radioactive waste (especially in fuel element fabrication, in nuclear power station operation, and in the reprocessing of spent reactor fuel rods) and an estimation of the amounts of waste to be expected for the future. The various possibilities of engineered storage or disposal of radioactive wastes are discussed with special regard to deep-sea dumping and disposal in deep salines which is also provided for in the FRG. A comprehensive system for waste disposal in nuclear engineering which must be and will be established in the FRG in the next decade is then discussed on the basis of radiation protection, safety, and protection considerations. The paper concludes by a short review on the present situation and on the future development of regulatory measures for the disposal of radioactive wastes. (DE)

26899 (BNWL-CC-887) EARTH SCIENCES WASTE DISPOSAL INVESTIGATIONS, JANUARY–JUNE 1966. Eliason, J. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1966. Contract AT(45-1)-1830. 16p. Dep. NTIS $3.50.

An evaluation is given of the ground water contamination resulting from disposal of plant effluents at Hanford. Analytical results are presented for gross beta activity in the unconfined ground water aquifer and gross beta activity at depths in the ground water. Results are given where concentrations of radionuclides are above the routine detection limit for gross beta. The average concentrations detected during the previous report period are listed for comparison. (JSR)

26900 (LA-6202-M) COMPUTERIZED LOW-LEVEL WASTE ASSAY SYSTEM OPERATION MANUAL. Jones, D. F.; Cowder, L. R.; Martin, E. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 40p. Dep. NTIS $5.00.

An operation and maintenance manual for the computerized low-level waste box counter is presented, which describes routine assay techniques as well as theory of operation treated in sufficient depth so that an experienced assayist can make nonroutine

assays. In addition, complete system schematics are included, along with a complete circuit description to facilitate not only maintenance and troubleshooting, but also reproduction of the instrument if desired. Complete software system descriptions are included so far as calculational algorithms are concerned, although detailed instruction listings would have to be obtained from Group R-1 at LASL in order to make machine-language code changes. (auth)

26901 SYSTEM OF TREATING FLUE GAS. Ziegler, D. L. (to U.S. Energy Research and Development Administration). US Patent 3,925,039. B01D47/10; B01D47/14; B01D47/16. 9 Dec 1975. Filed date 18 Nov 1974. 10p.

PAT-APPL-525,042.

A system is described for treating or cleaning incinerator flue gas containing acid gases and radioactive and fissionable contaminants. Flue gas and a quench solution are fed into a venturi and then tangentially into the lower portion of a receptacle for restricting volumetric content of the solution. The upper portion of the receptacle contains a scrub bed to further treat or clean the flue gas.

26902 MULTIUSE OF THE COASTAL ZONE AND MARINE ENVIRONMENT ALONG THE WEST COAST OF INDIA. Dwivedi, S. N. (National Institute of Oceanography, Goa (India)). pp 1-22, pt.BxCa114 of 2nd International Colloquium on the Exploitation of Oceans. Vol. 5. Oceanic Development Policies. Confrontation Sessions. Paris, France; Association pour l'Organisation de Colloques Oceanologiques a Bordeaux ([nd]).

From 2nd international colloquium on the exploitation of oceans; Bordeaux, France (1 Oct 1974).

Along the Indian coast major hazards come from sewage, industrial wastes, harbors, shipping, disposal wastes and hot water from atomic power plants. Some of these aspects are discussed. (FR)

Handling Equipment and Procedures

26903 KRITIKALITAETSSICHERHEIT BEI DER HERSTELLUNG UND HANDHABUNG VON KERNBRENNSTOFFEN. T. 1. Kritikalitaetsdaten fuer Uran-235-Metall-Leichtwasser-Mischungen. (Criticality Safety in Processing and Handling Fissile Materials. Pt. 2. Criticality Data for Uranium 235 Metal Light-Water Mixtures). Berlin, F. R. Germany; Beuth (Aug 1975). 8p. (In German). (DIN-25403(Pt. 2)).

5 figs.; 3 tabs.; 1 ref.

The present standard gives numerical values and curves for an isolated system of uranium 235 metal homogeneously dispersed in light-water at maximum reflection through light-water. (DE)

26904 KRITIKALITAETSSICHERHEIT BEI DER HERSTELLUNG UND HANDHABUNG VON KERNBRENNSTOFFEN. T. 3. Kritikalitaetsdaten fuer Plutonium 239-Metall-Leichtwasser-Mischungen. (Criticality Safety in Processing and Handling Fissile Materials. Pt. 3. Criticality Data for Plutonium 239 Metal Light-Water-Mixtures). Berlin, F. R. Germany; Beuth (Aug 1975). 7p. (In German). (DIN-25403(Pt. 3)).

5 figs.; 3 tabs.; 1 ref.

The present standard gives numerical values and curves for an isolated system of plutonium 239 metal homogeneously dispersed in light-water at maximum reflection through light-water. (DE)

Transportation

Refer also to abstracts 25560, 25561, 28247, and 28257.

26905 (SAND-75-0248A) TRANSPORTATION ENVIRONMENT DATA BANK INDEX. Davidson, C. A.; Foley, J. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 39p. Dep. NTIS $5.00.

In an effort to determine the environment intensities to which shipping containers will be exposed, a "Data Bank" of environmental information has been established by Sandia Laboratories, Division 1285 for the ERDA Division of Environmental Control Technology. This document is an index which can be used to request data of interest. (auth)

26906 (SAND-75-0426, pp 28-31) ACCIDENT-RESISTANT CONTAINERS FOR NUCLEAR WEAPONS. Berry, R. E. Feb 1976.

In Sandia technology, autumn 1975. (Sandia Labs., Albuquerque, N. Mex. (USA)).

To prevent detonation of high explosives in accidents during transportation of nuclear weapons, a practical technology for design of accident-resistant containers has been developed.

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 26943.

26907 (BNL-50445, pp 72-77) BEVALAC, A HIGH-ENERGY HEAVY-ION FACILITY: STATUS AND OUTLOOK. Grunder, H. A. (Univ. of California, Berkeley). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

The high-energy heavy-ion facility, which has commonly been referred to as the Bevalac, is a synchrotron with B rho of 9000 [kG-in or 2.3 x 10^2 kG-m] having special injectors. The synchrotron has three injectors. The 50 MeV proton injector, originally from BNL, is a tool left over from the high-energy high-intensity days of this productive synchrotron. The 20 MeV linac is a proton linac, designed so conservatively that it was possible to accelerate modest but useful beams of ^{12}C, ^{14}N, and ^{16}O as well as deuterons and alpha particles in the 2 beta lambda mode. This was accomplished in 1971. After our first trials, a suggestion made earlier by A. Ghiorso to inject from the SuperHILAC into the synchrotron was actively pursued. Reasons as to why the SuperHILAC is being used as injector to the Bevatron are given. (WHK)

26908 (BNL-50445, pp 79-85) HEAVY-ION, A greater than 200, ACCELERATION IN THE AGS. Prelec, K.; van Steenbergen, A. 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

Acceleration in the AGS of approximately 10^9 heavy ions per sec, with mass number A greater than 200, to kinetic energies of 1 less than T/sub N/ less than 10 GeV/nucleon is feasible without modification of basic AGS subsystems by using a (surplus) fast cycling synchrotron as a booster ring. This booster is required in order to obtain the fully stripped ion state, since partially stripped ion acceleration in a slow rise-time accelerator is impractical because of extreme vacuum pressure requirements. The fast cycling feature of the booster is essential in reducing transmission losses associated with electron capture or loss during acceleration and is beneficial in increasing the exit beam intensity.

26909 (BNL-50445, pp 86-89) PPA AS A RELATIVISTIC HEAVY-ION ACCELERATOR. White, M. G. (Princeton Univ., NJ). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

The feasibility of converting the Princeton Particle Accelerator (PPA) to a heavy ion facility with a booster accelerator is discussed. Options include a tandem Van de Graaff, a storage ring which would allow double acceleration in the PPA, and an improved ion source. (PMA)

26910 (CEA-N-1812) MONOENERGETIC NEUTRON PRODUCTION BELOW 20 MeV WITH VAN DE GRAAFF ACCELERATORS. Soleilhac, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Jul 1975. 20p. (In French). INIS.

The main parameters influencing the production of intense monoenergetic neutron sources below 20 MeV with Van de Graff accelerators are analyzed: choice of the reaction, secondary reactions, neutron production cross sections, neutron energy spread. The neutron yields for a given neutron energy spread are deduced for the useful reactions employed with solid or gaseous targets. (FR)

26911 (DESY-SR-75/10) ANGLE AND ENERGY DEPENDENCE OF PHOTOEMISSION FROM NaCl AND KCl SINGLE CRYSTALS. Himpsel, F. J.; Steinmann, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1975. 6p. INIS.

The dependence of the photoemission on the azimuthal emission angle at fixed polar angle of 45° was measured for the (100) face of NaCl and KCl single crystals cleaved in situ. The initial and final state energy was scanned using the synchrotron radiation of DESY. Strong variations of the angular pattern are observed for different final energies. Below the electron-electron scattering threshold, the pattern depends only on the final energy, irrespective of whether the level has been populated by direct optical excitation from the valence band or the K^+ 3p core level or by electron-electron-scattering from higher conduction band states. Electron-phonon scattering can account for this fact. The emission in the (110) direction is compared with an existing band structure calculation. (DE)

26912 (GSF-K-75, pp v) RADIATION-THERAPEUTICAL CONCEPT OF THE MEDICAL ACCELERATOR SYSTEMS OF SIEMENS AG. Schittenhelm, R. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

The radio-technical concept is described for the four Siemens AG accelerators used for radiation therapy, the 18 and 42 MeV betatrons and the 6 and 12 MeV linear accelerators. The basic structure and operation, and the utilization of the accelerated electrons as electron or X-radiation is dealt with. The beam aperture, the field diaphragm, dose measurements, and the control panel are described. (DE)

26913 (GSF-K-75, pp v) TECHNICAL CONCEPT OF ACCELERATOR PLANTS. Accelerator Plants BBC. Arx, A. von May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

A description is given of a 45 MeV betatron. The construction details which help meet the requirements for optimum radiation protection are considered. These specifications consist of a least possible radiation outside the signal field, the smallest contamination of the applied useful radiation, a reliable monitoring system, and the time stability of the beam bundle. The realization of these requirements is obtained by stabilization of the excitation current and of the emission current and by control equipment for optimum injection time and radiation energy. Beam aperture, radiation compensation, the monitor system for X-rays and electron radiation, the operational safety, and the available automation are described. (DE)

26914 (GSF-K-75, pp v) RADIATION SAFETY WITH MEDICAL ELECTRON ACCELERATORS, RADIATION PROTECTION MEASURES WITH EQUIPMENT. Kossel, F. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

A new safety concept for the operation of medical electron accelerators is presented. A former standard, in which the shielding safety precautions and the precautions against faulty functioning of the accelerator were not sufficient, was the starting point for the study. Besides reducing the leakage to a minimum, the program calls for the limiting of undesirable radiation. A series of control devices are needed to optimally protect the patients from injuries. (DE)

26915 (GSF-K-75, pp v) CONTROL MEASURES ON ACCELERATOR PLANTS. Pohle, G. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

According to the guidelines for the operation of accelerators in the medical field, the responsibility for safe operation falls on the physicist in charge. It is his task to test the functional safety of the system at certain time intervals. The necessary control measures and the time intervals in which they must be carried out are discussed, and examples of efficient performance are given. The necessary minimum of measuring equipment and the necessary laboratory and working space are briefly mentioned. (DE)

26916 (GSF-K-75, pp v) LEGAL AND TECHNICAL REGULATIONS IN THE MANUFACTURE AND OPERATION OF ACCELERATOR PLANTS IN MEDICINE. Pfaffelhuber, J. K. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Differences are explained between legal regulations and technical regulations in the manufacturing and operation of accelerators in medicine, and surveys on legal foundations for operation and

on the responsibility of supervising authorities are given. Guidelines for the operation are discussed, including personnel requirements, organizational outlines, structural measures for patient and personnel protection, stopping operation, and temporary solutions. Surveys on the valid legal regulations applying to atomic and radiation protection, the legal specifications on the transport of radioactive materials, and the relevant international and national standards are also given. (DE)

26917 (GSF-K-75, pp v) CLINICAL DOSIMETRY. Rassow, J. May 1973. (In German).

In radiation protection accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Applications of accelerators in physical dosimetry for medical treatment are discussed. Dose parameters, dose distributions important for clinical practice, and geometric irradiation parameters are defined and physical parameters such as accelerator energy and surface energy of average stopping power are dealt with in detail. A section on field homogenization with bremsstrahlung and electron radiation and details on dosimetry in clinical practice are given. A few problems in dosemeter and monitor calibration on accelerators are described. (DE)

26918 (GSF-K-75, pp v) RADIATION PROTECTION. Hoefer, O. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Precautions necessary to protect patients, personnel, and other persons from radiation from electron accelerators are described, using a 42 MeV betatron as an example. For radiation protection of the patients, control of the exact beam aperture is necessary. Methods for the determination of the dose rate outside the field, measurement of neutrons which occur as a result of (γ,n) and $(\gamma,2n)$ effects, and the ensuing air activation, are given. For the safety of the personnel, there are additional contamination controls, such as personnel dosimetry. For other persons, the monitoring of adjacent rooms, control of the vent air, and protection from activated patients are necessary. (DE)

26919 SLAC IS HEALTHY. CERN Cour.; 16: No. 1, 10-11 (Jan 1976).

A brief report of the operational status of SLAC is given. Among the topics discussed are polarized electron beams, the large aperture superconducting solenoid spectrometer (LASS), the electron-positron storage ring (SPEAR), the proposed 15 GeV electron-positron storage ring (PEP), and various experimental facilities. (PMA)

26920 SIN: A VERY SUCCESSFUL YEAR. CERN Cour.; 16: No. 2, 44-46(Feb 1976).

Operations at the Swiss Institute for Nuclear Research (SIN) during 1975 are briefly reviewed. SIN uses a two cyclotron system to produce intense 590 MeV proton beams, used primarily to generate high fluxes of mesons, which qualifies SIN as a meson factory. Topics discussed include the superconducting muon channel and experiments with pion beams for both nuclear physics and medical investigations. (PMA)

Auxiliaries and Components

26921 (FRNC-TH-541) AUTOMATION OF THE CONTROL OF AN ELECTRON LINEAR ACCELERATOR. Gourcy, G. (Paris-11 Univ., 91-Orsay (France)). 1975. 164p. (In French). INIS.

The automation systems installed on the Saclay AL 60 are described, including cabled systems for automatic supervision of the modulator and unmanned systems. Digital systems for measuring the beam characteristics and the adjustment quality are also presented. (FR)

26922 (GSF-K-75, pp v) ROUTINE MEASURING SYSTEM FOR THE PHYSICAL CONTROL OF A BETATRON. Schopka, H. J. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

A time-saving routine calibration and control system was developed for accelerators used in medicine. The system is described in detail, and includes external beam controls, energy calibration, mechanical auxiliary devices, and cabling systems. (DE)

26923 MEASUREMENTS ON A SUPERCONDUCTING *X*-BAND STRUCTURE FOR LINEAR ACCELERATOR APPLICATION. Arnolds, G.; Heinrichs, H.; Hoffmann, W.; Mayer, R.; Minatti, N.; Piel, H.; Proch, D.; Weingarten, W. (Fachbereich Physik, Gesamthochschule Wuppertal, Hofkamp 82, 56 Wuppertal 1, West Germany). J. Appl. Phys. 47: No. 3, 1134-1138 (Mar 1976).

We report on rf tests of a superconducting disk-loaded waveguide. A three-cell 8-GHz structure, fabricated of two pieces of bulk niobium, has been excited to high-field levels at temperatures below 1.8 °K. The cavity was operated in a $\pi/2$ standing-wave mode. Peak electric fields of 37 MV/m, peak magnetic fields of 590 Oe, and effective accelerating fields of 8.0 MV/m were generated at a microwave power level of 8 W/m. The lowest surface resistance that could be obtained was 44 nΩ corresponding to a Q factor of 4×10^9 at 1.3 °K. These results were achieved using electropolishing and annealing at 1400 °C under moderate vacuum conditions as surface treatments. The fields are limited by fast magnetic thermal breakdown. No electron loading was observed. (auth)

26924 RELATIVISTIC ELECTRON BEAM GENERATOR. Mooney, L. J.; Hyatt, H. M. (to U.S. Energy Research and Development Administration). US Patent 3,919,580. H01J1/30. 11 Nov 1975. Filed date 11 Sep 1974. 6p.

PAT-APPL-504,933.

A relativistic electron beam generator for laser media excitation is described. The device employs a diode type relativistic electron beam source having a cathode shape which provides a rectangular output beam with uniform current density.

26925 RING MAGNET FIRING ANGLE CONTROL. Knott, M. J.; Lewis, L. G.; Rabe, H. H. (to U.S. Energy Research and Development Administration). US Patent 3,914,681. H02M7/515. 21 Oct 1975. Filed date 6 Nov 1974. 10p.

PAT-APPL-521,418.

A device is provided for controlling the firing angles of thyratrons (rectifiers) in a ring magnet power supply. A phase lock loop develops a smooth ac signal of frequency equal to and in phase with the frequency of the voltage wave developed by the main generator of the power supply. A counter that counts from zero to a particular number each cycle of the main generator voltage wave is synchronized with the smooth AC signal of the phase lock loop. Gates compare the number in the counter with predetermined desired firing angles for each thyratron and with coincidence the proper thyratron is fired at the predetermined firing angle.

26926 PULSING EQUIPMENT FOR NEUTRON GENERATORS. Hannappel, L.; Schneider, H. (Giessen Univ. (F. R. Germany). Abt. Grossgeraete (Angewandte Kernphysik)). Kerntechnik; 17: No. 5, 235-239(May 1975). (In English, German)

8 figs.; 7 refs.

Various types of pulsing equipment for producing neutron pulses in conjunction with the most commonly used neutron generators (low voltage ion accelerators) are available on the market. A description is given of the working principles of pre- and post-acceleration pulsing, with and without bunching, and their advantages and disadvantages are discussed. Efficiency and operating experience data on a special nanosecond pulsing system are given. (DE)

26927 SUPERCONDUCTING COILS FOR THE MUON CHANNEL SYSTEM AT THE SWISS INSTITUTE FOR NUCLEAR RESEARCH. Fillunger, H.; Horvath, I. Brown Boveri Rev.; 62: 496-500(1975).

Brown Boveri manufactured 30 superconducting coils under contract to the Swiss Institute for Nuclear Research (SIN). The coils were made from carefully chosen materials and impregnated using a special technique, then tested at 4.8°K in the low-temperature laboratory. A typical oscillogram of a transition into the normal conducting condition is shown and is compared with theoretical calculations. On the basis of many experiments, it is possible to make some general statements about the phenomena which were observed. (auth)

26928 LEAK TESTING IN THE CERN ISR AT GENEVA. Marcellin, J. (Societe Generale d'Etudes Mecaniques et Electriques (SOGEME), 26-Bourg-les-Valence (France)). pp 31-37 of Meeting on Leak Detection and Helium-Tightness Tests. May 16, 1972. Proceedings. Paris, France; Comite Francais d'Etude des Essais Non Destructifs ([nd]). (In French)

From meeting on leak detection and helium-tightness tests; Paris, France (16 May 1972). Special edition of Revue de Metallurgie and Soudage et Techniques Connexes.

The pressure tends towards the 10^{-11} torr level. The design and leak testing of the vacuum chamber are described. (FR)

26929 1000 GeV NEXT STOP. CERN Cour.; 16: No. 1, 12-13(Jan 1976).

A brief review is given of the status of the Energy Doubler/Saver, a project at Fermilab to double the peak energy by adding a ring of superconducting magnets. The experimental motivation for the project, the power consumption of the magnets, and the magnet cooling system are discussed. (PMA)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 27194.

26930 (GSF-K-75, pp v) STRUCTURAL RADIATION PROTECTION MEASURES FOR MEDICALLY USED ELECTRON ACCELERATORS. Frost, D. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Recommendations are given for radiation protection measures for electron accelerators. The specifications for minimum radiation exposure to the personnel and that absolutely necessary to the patient are discussed, and the radiation due to neutron activation of materials and air and the higher power of modern accelerators are considered. Materials problems for shielding are also discussed. (DE)

26931 (LBL-3399(Suppl.), pp I.3.1-I.3.6) OSCILLATIONS IN A DUOPLASMATRON ION SOURCE. Kobayashi, M.; Takagi, A. (National Lab. for High Energy Physics, Ibaraki-ken, Japan). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Coherent oscillations with the frequencies of 1 to 3 MHz were observed in a high current pulsed duoplasmatron for hydrogen gas. The dependences of the frequencies and amplitudes on the source parameters are presented. The oscillation frequency increases as B increases. It is inversely proportional to the I. E.-to-anode distance, and has an approximate dependence of 1 root M for different gases. It seems reasonable to explain the oscillation in terms of ion-acoustic wave in the anode plasma. Operation at high arc current with weak magnetic field is favorable for obtaining oscillation-free beams. (auth)

26932 (LBL-3399(Suppl.), pp II.5.1-II.5.6) DUOPLASMATRON WITH A NOZZLE TYPE PLASMA EXPENSION CUP. Kobayashi, M.; Nishikawa, T.; Takagi, A. (National Lab. for High Energy Physics, Ibaraki-ken, Japan). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA).. Lawrence Berkeley Lab.).

Various tests are described which were carried out in order to clarify the cause of the aberration existing in the beams extracted from a nozzle type plasma expansion cup. The tests involve the extraction electrodes having different edge shapes, gridded extraction electrodes, high-voltage facing electrodes at the cup exit making different angles with the axis, plasma cups having different contours at the exit, plasma cups gridded at the exit, biasing the cup exit with respect to anode, plasma cups having different ratios of the exit area to axial length, etc. The results show that the inward meniscus type distortion of the plasma boundary near the rim of plasma cup will be a dominant source for the aberration. Both proper shaping of the contour of the cup exit and biasing the cup exit reduced the aberration. (auth)

26933 (LBL-3399(Suppl.), pp II.6.1-II.6.5) CONTINUOUSLY DISPLAYED EMITTANCE MEASUREMENTS. Billen, J. H. (Univ. of Wisconsin, Madison). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A description is given of a device to display continuously on a CRT the emittance of an ion beam. The system uses electrostatic deflectors and small apertures to scan the beam transverse position and momentum coordinates. Measurements here reported include: (1) emittance and brightness of many different ion beams from five different type sources; (2) a study of the emittance of an H^- beam as a function of the radial displacement of the zwischen electrode in a duoplasmatron direct extraction source; and (3) a phase space particle density profile for a H^- beam. (auth)

26934 (LBL-3399(Suppl.), pp III.3.1-III.3.6) ION SOURCES FOR A COLLECTIVE ION ACCELERATOR. Olson, C. L.; Kuswa, G. W.; Swain, D. W.; Poukey, J. W. (Sandia Labs., Albuquerque, NM). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Collective ion acceleration schemes that utilize an intense relativistic electron beam (approximately 1.5 MeV, 30 kA, 70 ns) to create a deep, moving potential well (for accelerating and focusing an ion bunch) have been recently proposed. In these schemes, the ion source would provide a pulsed, partially-stripped, essentially stationary ion bunch. The proposed final accelerated ion bunch current would be less than 100 A and the pulse length would be less than 1 ns. Three different ion sources appropriate for these collective acceleration applications were investigated. These include e-beam extraction and acceleration of ions from: (1) a beam-ionized neutral gas; (2) a beam-vaporized and beam-ionized solid thin film target; and (3) a laser-irradiated solid target embedded in the anode foil. Method (1) has been demonstrated previously. Methods (2) and (3) appear to be feasible based on theoretical work presented here, although present experimental results (also presented here) were dominated by anode foil impurity ions. For collective acceleration applications, the necessity of using these pulsed, effectively high-current sources instead of conventional sources is noted. (auth)

26935 (LBL-3399(Suppl.), pp IV.1.1-IV.1.7) POLARIZED ION SOURCES. Glavish, H. F. (Stanford Univ., CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A brief account is given of the motivation for building polarized ion sources. This is followed by a simple description of the basic principles of the "ground state" and "Lamb shift" types of sources. The performance levels currently achieved are discussed, and detailed diagrams of actual sources are included. There is a section on the recent application of a polarized ion source to the Argonne Zero Gradient Synchotron. References are given which relate to the possibility of producing polarized particles other than protons and deuterons. Developments that might lead to increased beam currents are discussed. (auth)

26936 (LBL-3399(Suppl.), pp IV.4.1-IV.4.2) DESIGN AND OPERATION OF THE McMASTER POLARIZED ION SOURCE (II). McKay, J. W. (McMaster Univ., Hamilton, Ont.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A Lamb Shift spin filter polarized ion source was constructed for the McMaster University F. N. Tandem Accelerator. Cryogenic pumping devices were used in the argon cell region to control the heavy gas loads and to ensure clean vacuum conditions. Initial testing of the source is also discussed. (auth)

26937 (LBL-3399(Suppl.), pp IV.5.1-IV.5.6) COMPARISON OF HIGH-INTENSITY MULTIAPERTURE AND SINGLE-APERTURE DUOPLASMATRONS FOR A LAMB-SHIFT POLARIZED ION SOURCE. Trainor, T. A. (Univ. of North Carolina, Chapel Hill, NC); Clegg, T. B. 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A high intensity duoplasmatron was constructed, and two different extraction systems were used with this ion source to produce positive ion beams for a Lamb-shift source. The multiaperture system consists of a 2 cm dia hexagonal array of 55 apertures, each 2.2 mm dia, in three aligned electrodes. Total extracted beam with this system is typically 50 mA. A 1.1 kV D^+ ion beam of 24 mu A is delivered to a 1.25 cm dia suppressed Faraday cup 160 cm from the ion source. The single-aperture system consists of two 70^0 conical electrodes separated by a flat 3.2 mm thick electrode with a 6.3 mm dia aperture at the center. Total extracted beam with this system is typically 10 mA. A beam intensity of 11.5 mu A is observed at the Faraday cup. Arc currents during these measurements are typically 20 A. Polarized beam quality with the single-aperture extraction system is far superior to that corresponding to the multiaperture system. Factors contributing to this result are discussed. (auth)

26938 (LBL-3399(Suppl.), pp IV.6.1-IV.6.2) LAMB-SHIFT POLARIZED H^- SOURCE FOR THE UNIVERSITY OF MANITOBA CYCLOTRON. Oh, S.; McIlwain, A. (Univ., of Manitoba, Winnipeg). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A Lamb-shift polarized H^- source is being planned for use with the University of Manitoba Cyclotron. The source will employ the diabatic field reversal method. Construction will allow the possibility of conversion to the spin filter type later. Construction of the accompanying external injection system is in progress. (auth)

26939 (LBL-3399(Suppl.), pp IV.8.1-IV.8.4) PERFORMANCE OF A GROUND STATE POLARIZED ION SOURCE IN THE HIGH VOLTAGE TERMINAL OF THE OHIO STATE CN VAN DE GRAAFF ACCELERATOR. Donoghue, T. R.; McEver, W. S.; Schieck, H. P.; Volkers, J. C.; Busch, C. E.; Doyle, M. A.; Dries, L.; Regner, J. L. (Ohio State Univ., Columbus). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A polarized ion source was constructed for operation in the high voltage terminal of a pressurized Van de Graaff accelerator. A report is given on the recent developments that have contributed to the successful operation of this source within the accelerator. The source is currently used for nuclear physics experiments, with typical beam and polarization on target of 60 nA and p/sub y/ equals 0.65 for protons and 30 nA and p/sub zz/ equals 0.80 for deuterons. (auth)

26940 (LBL-3399(Suppl.), pp IV.9.1-IV.9.5) POLARIZED BEAM FACILITY IN GIESSEN, GERMANY. Arnold, W.; Clausnitzer, G. (Univ., Geissen, Ger.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The source of polarized particles employs the Lamb shift method, using two quenching coils with a Sona-transition region in between. Negative hydrogen currents of 600 nA were obtained from the source and injected into a small pressurized 1.2 MeV tandem-accelerator. Polarized proton currents of 300 to 400 nA were measured after a 1 mm x 1 mm aperture with a polarization of 64 percent, determined from the ^{3}Be(p,alpha)-asymmetry. (auth)

26941 (LBL-3399(Suppl.), pp V.1.1-V.1.17) PRINCIPAL PARAMETERS OF CLASSICAL MULTIPLY CHARGED ION SOURCES. Winter, H. (Technische Hochschule, Vienna); Wolf, B. H. 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A review is given of the operational principles of classical multiply charged ion sources (operating sources for intense beams of multiply charged ions using discharge plasmas; MCIS). The fractional rates of creation of multiply charged ions in MCIS plasmas cannot be deduced from the discharge parameters in a simple manner; they depend essentially on three principal parameters, the density and energy distribution of the ionizing electrons, and the confinement time of ions in the ionization space. Simple discharge models were used to find relations between principal parameters, and results of model calculations are compared to actually measured charge state density distributions of extracted ions. Details of processes which determine the energy distribution of ionizing electrons (heating effects), confinement times of ions (instabilities), and some technical aspects of classical MCIS (cathodes, surface processes, conditioning, life time) are discussed. (auth)

26942 (LBL-3399(Suppl.), pp VII.9.1-VII.9.4) ICT HIGH EFFICIENCY DUOPLASMATRON ION SOURCE. Booth, R. (Univ. of California, Livermore). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The duoplasmatron ion source of the Livermore 400 kV ICT accelerator was modified to increase the target current from the accelerator. In routine operation, D^+ currents on target of 18 to 22 mA are now produced rather than the 5 to 8 mA originally available. The major modification to the source was the installation of a focus electrode between the plasma expansion cup and the accel-decel extraction electrode system. With this arrangement, the source output may be varied from maximum down to zero beam level without excessive extractor loading. Beam divergence varies from 6 mrad to 30 mrad. The focusing and extraction electrodes are simple to fabricate and are radiation cooled. Beam transport efficiency of 75 percent was obtained through the 15 m long x 10 cm diameter transport system. The increase in target current was obtained without decreasing the reliability of the accelerator. (auth)

26943 (LBL-3399(Suppl.), pp VII.12.1-VII.12.5) PERFORMANCE OF A MODERATE INTENSITY ION SOURCE AND ACCELERATOR FOR USE IN NEUTRON RADIOTHERAPY. DeLuca, P. M.; Tesmer, J. R.; Chenevert, G. M.; Torti, R. L.; Kelsey, C. A. (Univ. of Wisconsin, Madison). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A neutron generator, consisting of a duoplasmatron, a "Pierce-type" accelerating structure, and a windowless gas target was constructed. The device is designed to provide a relatively inexpensive intense source of fast neutrons for cancer treatment. The neutrons (15 MeV) are produced by the ^{3}H(d,n)^{4}He reaction. Among the characteristics of the system discussed are ion source and gas target performance, beam emittance, and neutron production. (auth)

26944 (LBL-3399(Suppl.), pp VIII.2.1-VIII.2.12) NEGATIVE HYDROGEN SOURCES FOR BEAM CURRENTS BETWEEN ONE MILLIAMPERE AND ONE AMPERE. Sluyters, T. (Brookhaven National Lab., Upton, NY). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A review is given of the methods employed in the production of negative hydrogen ions in the current range of 1 mA to 1A. (auth)

26945 (LBL-3399(Suppl.), pp VIII.3.1-VIII.3.3) DEVELOPMENT OF A DIRECT EXTRACTION ION SOURCE FOR AN FN VAN DE GRAAFF TERMINAL. Roth, G. W.; Weitkamp, W. G. (Univ. of Washington, Seattle). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A direct extraction duoplasmatron ion source was installed in the terminal of the negative injector of the University of Washington HVE three-stage model FN Van de Graaff accelerator. With this ion source, the injector produces hydrogen ion beams of higher intensity than was possible with the previous neutral negative configuration. It also produces intense heavy ion beams which can be more highly ionized by the tandem stripper foil, because the beam energy at the foil is about twice as high as was possible previously. The result is a significant increase in total accelerator beam energy for heavy ions. The installation minimizes volume, weight, and power consumption, while preserving ease of maintenance. The duoplasmatron is gas cooled, with a permanent magnet produced plasma constriction field, and a glass filament holder containing two filaments. Operating parameters are monitored using analog optical telemetry channels. The source performs satisfactorily and has been used for nuclear research. (auth)

26946 (LBL-3399(Suppl.), pp VIII.7.1-VIII.7.3) IMPROVEMENT IN PERFORMANCE OF AN ALKALI VAPOR CHARGE EXCHANGE CANAL. Dumail, M.; Denoit, M.; Le Scornet, J. C. (Institut de Physique Nucleaire, Orsay, France). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

In negative ion sources with alkali metal vapor charge exchange canals, the generated beam output decreases, often rapidly, with time. A new canal and new refrigerated baffles were designed so that the condensed alkali metal is located off the axis, and extends beyond the internal edge of the baffles. Under these conditions, the performance of the negative source remains constant as long as there is some metal in the reservoir. (auth)

26947 (LBL-3399(Suppl.), pp VIII.9.1-VIII.9.4) SPUTTER PIG SOURCE (SPIGS) FOR NEGATIVE IONS. Smith, H. V. Jr.; Richards, H. T. (Univ. of Wisconsin, Madison). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A description is given of a radial extraction Sputter PIG Source (SPIGS) which uses cathode sputtering by an argon plus cesium

vapor discharge to produce a wide variety of low emittance negative ion beams, including metallic ions. With appropriate cathodes the following intensities were possible: C^-, 3 mu A; V^-, 0.1 mu A; Ni^-, 4 mu A; Cu^-, 8 mu A; and Nb^-, 0.2 mu A. The source can also be used for the gaseous elements by using low sputtering cathodes and the appropriate parent gas for the discharge. The operating lifetime of the present version of SPIGS is approximately 100 hours. SPIGS is compared with other sources of negative metallic ions, and a possible explanation for the reported higher emittance of another source is offered. Work continues on improving beam intensities, source operating lifetime, and extending the negative ion species available. (auth)

Ion Optics and Field Calculations

26948 (JINR-9-8289) FOCUSING OF AN INTENSIVE ELECTRON BEAM IN THE SILUND INDUCTION LINEAR ACCELERATOR. Belyaev, A. P.; Derendyaev, Yu. S.; Dolbilov, G. V.; Kovalenko, A. D.; Obukhov, Yu. L.; Reshetnikova, K. A.; Sarantsev, V. P.; Sumbaev, A. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1974. 13p. (In Russian). INIS.

3 refs.; 6 figs.

Results are presented of using the Runge–Kutta method to solve numerically the parallel-axial equation of motion of an electron beam in the real structure of a linear induction accelerator. It is shown with this approximation that the focusing system of the accelerator SILUND can carry electron beams having a current up to 10 kA. By the method of "large particles", calculations were made of the oscillations of the radial projection of the beam phase volume on a length of one accelerating section. (tr-auth)

26949 EFFECT OF THE LENGTH AND STRUCTURE OF THE CURRENT PULSE ON THE BEAM INTENSITY IN A LINEAR ACCELERATOR. Beloglazov, V.I.; Grishaev, I.A.; Kramskoi, G.D.; Fursov, G.L.; Shendrik, V.A. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 20: No. 7, 928-931 (July 1975).

The critical current in a section of a linear electron accelerator is studied as a function of the length and shape of the current pulse. The critical charge is found to increase linearly with increasing pulse length. (auth)

26950 GENERAL CLASS OF LAMINAR SOLID ELECTRON BEAMS. Wolfram, R. (Siemens AG, Munich). Arch. Elek. Uebertrag.; 28: No. 10, 433-438(Oct 1974). (In German)

Most electron beams of velocity-modulated tubes do not have the ideal configuration of radially constant space-charge density. On the contrary, differences in emission across the cathode cause radial variations in space-charge density and vortical frequency. Solid electron beams normally used in practice can be assigned to a general class of beams. This is derived assuming a cathode flux ratio varying quadratically with radius. A difference between flux ratio at the center and edge of the beam is introduced as parameter of the beam class. Focusing is not influenced. However, for calculations on the high frequency interaction, in particular dispersion and plasma reduction factor, the question of improving the available data is covered. A diagram permits improved estimation of beam profiles under the influence of thermal electrons including profile dip on the axis. (Electr. Electron Abstr.)

Storage Rings

Refer also to abstract 26919.

Experimental Facilities

Refer also to abstracts 26035 and 27386.

26951 (GSF-K–75, pp v) CONCEPT OF THE SAFETY PRECAUTIONARY MEASURES WITH THE LINEAR ACCELERATOR SL 75/10. Calamini, A.; Mueller, C. H. F. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

A brief description is given of the construction and operating principle of the SL 75/10 linear accelerator for 3, 4, 6, 8 and 10 MeV electron beams. Safety precautionary measures are discussed, including: (1) measures to keep the irradiation properties constant (automatic monitoring); (2) safety precautions in using accessories; (3) control devices; and (4) check lists for the routine control of certain data at regular time intervals. (DE)

26952 (MPI-PAE-EXP.EL–45) A STREAMER CHAMBER DETECTOR AT THE CERN. Intersecting Storage Rings. Eggert, K.; Thome, W.; Betev, B.; Bohm, G.; Darriulat, P.; Dittmann, P.; Gygi, E.; Holder, M.; McDonald, K. T.; Modis, T. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Feb 1975. 25p. INIS.

16 figs.; 5 refs. Available from ZAED. Submitted to Nucl. Instrum. Methods.

The design, construction, and performance of a streamer chamber system for the study of inelastic proton-proton collisions at the CERN ISR are described. The chambers have specially shaped ground electrodes to accommodate the ISR vacuum chamber and to obtain an almost 4π solid angle. Problems arising from the non-flat electrodes and the insertion of converter plates into the sensitive volume of the chambers are discussed. The high voltage and gas system are described, and details are given of the control system for the streamer chamber memory time, which is essential for operation at high ISR luminosities. The optical system, including single stage electrostatic image intensifiers, is explained. The chambers are triggered on inelastic beam-beam interactions with counter hodoscopes or on interactions including a photon which is detected in a lead glass Cerenkov counter located at 90°. (DE)

26953 (PTB-ND–9) TIME-OF-FLIGHT NEUTRON SPECTROSCOPY WITH A COMPACT CYCLOTRON. Siebert, B.R.L.; Jahr, R. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany). Neutronendosimetrie). Apr 1975. 19p. (In German). INIS.

A cyclotron is of use in time-of-flight spectroscopy even if the precondition "single turn extraction" is not fulfilled. The ions in the main and interference pulse must then have the same energy. A generalized program is described which enables the development if the energies of the main and interference pulse are not the same. A realistic, computer-simulated $^{27}Al_{13}$ (n,n') $^{27}Al_{13}$ time-of-flight spectrum is shown, and the method is described using this example. The errors are discussed. (DE)

26954 COMPUTER DOSIMETRY FOR FLATTENED AND WEDGED FAST-NEUTRON BEAMS. Hogstrom, K.R. (T. W. Bonner Nuclear Laboratories, Rice University, Houston, Texas 77001); Smith, A.R.; Almond, P.R.; Otte, V.A.; Smathers, J.B. Med. Phys. 3: No. 1, 26-30 (Jan 1976).

Beam flattening by the use of polyethylene filters has been developed for the 50-MeV $d \rightarrow$Be fast-neutron therapy beam at the Texas A&M Variable-Energy Cyclotron (TAMVEC) as a result of the need for a more uniform dose distribution at depth within the patient. A computer algorithm has been developed that allows the use of a modified decrement line method to calculate dose distributions; standard decrement line methods do not apply because of off-axis peaking. The dose distributions for measured flattened beams are transformed into distributions that are physically equivalent to an unflattened distribution. In the transformed space, standard decrement line theory yields a distribution for any field size which, by applying the inverse transformation, generates the flattened dose distribution, including the off-axis peaking. A semiempirical model has been constructed that allows the calculation of dose distributions for wedged beams from open-beam data. (auth)

26955 ELECTRON BEAM TREATMENT-PLANNING SYSTEM. Bagne, F. (Radiation Therapy Department, Dartmouth-Hitchcock Medical Center, Hanover, New Hampshire 03755). Med. Phys. 3: No. 1, 31-38 (Jan 1976).

Some of the physical parameters necessary in electron beam treatment planning are investigated for 5- to 45-MeV electrons extracted from a Brown-Boveri betatron. The percent depth ionization (PDI) curves are compared with the empirical relation given by Laughlin's equation, and an extension of Laughlin's equation is described. The modified absorption coefficient (MAC) method is introduced to correct the isodose distributions for the presence of inhomogeneities, such as lung, with the actual density of lung and the location of the inhomogeneity taken into consideration. Experimental data from measurements made in a water-cork phantom are presented, and the results are compared with the various calculated methods. (auth)

26956 METHOD OF MEASURING A PROFILE OF THE DENSITY OF CHARGED PARTICLES IN A PARTICLE BEAM. Hyman, L. G.; Jankowski, D. J. (to U.S. Energy Research and Development Administration). US Patent 3,911,280. G01T1/16. 7 Oct 1975. Filed date 11 Apr 1974. 8p.

PAT-APPL-460,228.

A profile of the relative density of charged particles in a beam is obtained by disposing a number of rods parallel to each other in a plane perpendicular to the beam and shadowing the beam. A second number of rods is disposed perpendicular to the first rods in a plane perpendicular to the beam and also shadowing the beam. Irradiation of the rods by the beam of charged particles creates radioactive isotopes in a quantity proportional to the number of charged particles incident upon the rods. Measurement of the radioactivity of each of the rods provides a measure of the quantity of radioactive material generated thereby and, together with

the location of the rods, provides information sufficient to identify a profile of the density of charged particles in the beam.

26957 TRACK SENSITIVE TARGETS: FURTHER STEP FORWARD AT ARGONNE. CERN Cour.; 16: No. 2, 47-49(Feb 1976).

A brief summary is given of the operation of the track sensitive target (TST) in the Argonne 12 foot bubble chamber, a program involving a high degree of international collaboration. The design principles, problems with development, and a bubble chamber picture are presented. (PMA)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

26958 (ESRO-SP-107, pp 11-17) GERMAN NATIONAL SCIENTIFIC BALLOON AND SOUNDING-ROCKET PROGRAM. Joneleit, D. (DFVLR, Oberpfaffenhofen, Ger.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92 – Neuilly-sur-Seine (France)).

Cosmic Radiation

Refer also to abstracts 26992 and 27042.

26959 ADIABATIC FERMI ACCELERATION OF ENERGETIC PARTICLES BETWEEN CONVERGING INTERPLANETARY SHOCK WAVES. Levy, E.H.; Duggal, S.P. (Bartol Research Foundation of the Franklin Institute, Swarthmore, Pennsylvania 19081). J. Geophys. Res. 81: No. 1, 51-59 (1 Jan 1976).

The process of adiabatic acceleration of relativistic cosmic rays between two converging shocks, through the first-order Fermi mechanism, to which the unusual ground level event (GLE) of August 4, 1972, was attributed earlier is examined quantitatively, the nature of interplanetary shock waves and their propagation being taken into account. In the formal computational model the net evolution of the particle flux is determined by the balance between the acceleration of particles reflected from the moving shock waves and the loss of those particles which pass through the shocks. Comparison of the results of the theoretical calculations with the measurements has revealed that the observed abnormalities are a natural consequence of the proposed process. In particular, the computed times of maximum and the ratio of the enhancement at the mountain altitude South Pole station to that at the sea level polar neutron monitors are in good agreement, as is the rapid decay of the particle flux after the maximum. The initial growth of the nucleonic intensity appears to be delayed with respect to the prediction, but this discrepancy can be ascribed to the complexities in attempting to uniquely disentangle the GLE from the behavior of the total cosmic ray flux and to the late development of the particle reflection coefficient of the interplanetary shock fronts. An intensive search has revealed that the requisite conditions for observing GLE representing acceleration between converging shocks has occurred only twice over a period of two solar cycles, and on both occasions an abnormal GLE was in fact observed. (auth)

26960 ORGANIZATION OF THE HIGH-ENERGY COSMIC RAY EXPERIMENTS CONDUCTED BY THE EARTH SATELLITE PROTON-4. Bugakov, V. V.; Belyakov, S. A.; Grigorov, N. L.; Gubin, Yu. V.; Kalinkin, L. F.; Kakhidze, G. P.; Rapoport, I. D.; Savenko, I. A.; Smirnov, A. V.; Shiryaeva, V. Ya.; Shishkov, P. P.; Shesterikov, V. F.; Yakovlev, B. M.; Trigubov, Yu. V. Bull. Acad. Sci. USSR, Phys. Ser.; 34: No. 9, 1613-1622(Sep 1970).

From All-Union conference on cosmic ray physics; Leningrad, USSR (9 Oct 1969). Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: No. 9, 1818-1828(Sep 1970).

Experiments are carried out with instruments capable of measuring the energies and electric charges of the primary particles with greater accuracy and reliability. The proton-nucleus inelastic interaction cross sections are measured with a different type of apparatus. A direct study of the form of the primary particle spectrum in the energy region up to 10^{15} eV is made and information on the interactions of the complex nuclei in the high- and ultrahigh-energy cosmic rays is obtained. (auth)

26961 EFFECT OF THE UNIVERSAL RADIATION FIELD ON HIGH ENERGY COSMIC NEUTRINOS. Mickens, R. E. (Fisk Univ., Nashville). J. Tenn. Acad. Sci.; 50: No. 4, 127-129(Oct 1975).

The interaction of high energy cosmic-ray neutrinos with the 3^0K universal radiation field is calculated. In contrast to the situation with protons, electrons, and photons, no cut-off to the neutrino cosmic-ray energy spectrum should occur. (auth)

26962 MEASUREMENT OF THE SPECTRAL INDEX OF DISTRIBUTED COSMIC RADIO EMISSION AT DECIMETER WAVELENGTHS. Chernyshev, V. I.; Stankevich, K. S. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1706-1708(1975). (In Russian)

26963 DIFFUSE COSMIC GAMMA RADIATION. Schoenfelder, V. (Max-Planck Institut fuer extraterrestrische Physik, Garching, Ger.). Fortschr. Phys.; 23: No. 1, 1-69(1975). (In German).

A critical evaluation is made of the present knowledge of diffuse cosmic gamma radiation. The experiments made in this area are described and their reliability tested. Theoretical hypotheses on the origin of this cosmic radiation are discussed and it is concluded that as yet there is no satisfactory explanation for their origin. 94 references. (JSR)

26964 DEPENDENCE OF THE SPACE DISTRIBUTION FUNCTION OF EAS MUONS UPON THE AGE PARAMETER S. Iliyna, N. P.; Kalmykov, N. N. (Moscow State Univ.). Yad. Fiz.; 22: No. 5, 1035-1039(Nov 1975). (In Russian).

The general EAS development model is used to obtain the space distribution functions of muons in the showers with a fixed number of electrons at sea level. It is shown that selection of EAS according to the values of the age parameter S changes the space distribution function of muons. 4 figures (auth)

Stars

Refer also to abstracts 27024, 27026, 27028, 27029, 27771, 27921, 27925, and 27937.

26965 (ESRO-SP-107, pp 211-215) SURVEY OF ATTITUDE-CONTROL AND RECOVERY SYSTEMS FOR THE CURRENT GERMAN SOUNDING-ROCKET PROGRAM. Krieg, E. (DFVLR, Oberpfaffenhofen, Ger.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92 – Neuilly-sur-Seine (France)).

26966 (MPI-PAE/ASTRO-69) EVOLUTION OF HELIUM RICH STARS WITH HYDROGEN BURNING. Roeser, M. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Aug 1975. 14p. INIS.

Evolutionary tracks of stars with an initial chemical composition X = 0.100, Y = 0.8790, Z = 0.021 are calculated for masses of 0.35 M(sun), 0.66 M(sun), 1.00 M(sun), 2.00 M(sun), and 5.00 M(sun) and with X = 0.302, Y = 0.677, Z = 0.021 for masses of 1.00 M(sun), 3.00 M(sun), and 5.00 M(sun). The evolution is followed from hydrogen burning to helium burning and to carbon burning when the occasion arises. The data of evolution are presented and compared with normal Population I-stars. The helium rich stars show higher effective temperatures, much higher luminosities and therefore shorter time scales. They are situated in regions of the HR-diagram where observed helium stars are found. (DE)

26967 BLACK-AND-WHITE-HOLES. I. Faster-Than-Light Phenomena and Their Connection with the Complete Schwarzschild Manifold. Goldoni, R. (Scuola Normale Superiore, Pisa, Italy). Acta Phys. Austriaca; 41: No. 2, 133-139(1975).

A general relativity generalization of the space-time previously introduced in the special relativity theory of superluminal frames. It is concluded that within general relativity tachyons and bradyons can exchange not only internal quantum numbers (as in special relativity), but also external quantum numbers, and that the four Schwarzschild regions contained in the complete Schwarzschild manifold can be interpreted as a general relativistic generalization of the slow and fast regions of the space-time discussed in special relativity. (auth)

26968 BLACK-AND-WHITE HOLES. Goldoni, R. (Scuola Normale Superiore, Pisa, Italy). Acta Phys. Austriaca; 41: No. 1, 75-82(1975).

A physical interpretation of the peculiar feature of the complete Schwarzschild manifold M of being the union of four regions with an infinite space-like extension is suggested. The Finkelstein time is assumed to order causally the events, instead of the Kruskal time. As a consequence of this assumption, the mutual causal behavior of the four Schwarzschild regions contained in M allows to conceive a dynamical mechanism which could produce the main features of M in some region of space-time. Assuming the strong principle of equivalence, one predicts a significant blue shift of the radiation emitted by matter emerging from the r = 0 singularity. This phenomenon was not observed. A way to reconcile the assumption that M is physical with the absence of blue shifts

is to require only a weaker equivalence principle, namely the local validity of the principle of (special) relativity in any local inertial frame. From such an invariance principle, to which one cannot renounce without giving up the whole theory of relativity, it is possible to deduce the ratio between the frequencies (as measured by an observer at rest in the asymptotically flat domain) emitted by two identical transmitters at the Schwarzschild times in which they reach the same 3-space point of the exterior Schwarzschild region along different geodesics. (auth)

26969 RESTRICTED ITERATIVE MINIMIZATION METHOD FOR ANALYZING LIGHT CURVES OF CLOSE BINARY SYSTEMS. Horak, T. B. (Inst. of Applied Geophysics, Brno). Bull. Astron. Inst. Czech.; 26: No. 5, 257-270(1975).

A modification of the iterative minimization method, which allows the limb darkening coefficients to remain fixed during minimization, is presented. The calculated elements of UV Leo, RX Ari and V 338 Her are the same as the elements obtained by classical methods. New elements of RS Cha were determined: i = 83.8°, R = 0.225, r = 0.261 in the blue and i = 83.6°, R = 0.222, r = 0.264 in the yellow. A three-dimensional presentation of the minimized function Σ demonstrates some basic features of the method. (auth)

26970 EFFECTS IN THE QUANTITATIVE ANALYSIS OF STELLAR SPECTRA. Zverko, J. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 26: No. 5, 271-273(1975).

The consequences of inaccuracies in determining the temperature and microturbulence for the resultant values of element abundances are discussed. The effect of the inaccurate determination of the temperature is eliminated if only lines of a more abundant ion of the element are used in the analysis. An inaccurate estimate of the magnitude of the microturbulence is reflected in a larger error for heavier elements. The inaccuracies in determining both values may result in apparent overabundances or underabundances of the elements. (auth)

26971 SPECTROSCOPY OF FIVE FAINT M DWARF STARS NEAR THE NORTH GALACTIC POLE. Koo, D. C.; Kron, R. G. (Univ. of California, Berekeley). Publ. Astron. Soc. Pac.; 87: No. 520, 885-889(Dec 1975).

Radial velocities and estimates of absolute magnitudes are presented for five M dwarfs selected from a proper motion study of M stars near the north galactic pole by Murray and Sanduleak. Our derived mean distance and velocity dispersion are significantly larger than the corresponding quantities found by Murray and Sanduleak, but we have only a small sample limited to the earlier-type stars on their list. (auth)

26972 NEW COLOR-MAGNITUDE DATA FOR TWELVE GLOBULAR CLUSTERS. Harris, W.E. (David Dunlap Observatory, Richmond Hill, Ontario, Canada). Astrophys. J. Suppl. Ser. 29: No. 292, 397-429 (Oct 1975).

This paper presents results of a major program of *BV* photoelectric and photographic photometry of southern globular clusters. The observational data for this program have been obtained primarily at Las Campanas, Chile, with additional material from Cerro Tololo. New color-magnitude diagrams are presented for 11 clusters (NGC 2808, 4590, 5694, 5824, 6325, 6517, 6681, 6715, 6809, 6864, and 7089); and for one additional cluster (NGC 6266) measurements of the variable stars are listed. For 10 of these objects, no C-M diagrams in the *UBV* system have previously been published. The features of the diagrams are discussed briefly and used to derive basic information about the clusters, such as their distances, reddenings, and characteristics of the giant and horizontal branches. More extensive discussions are presented for four particularly interesting clusters (NGC 2808, 5694, 6864, and 7089). The first of these (NGC 2808) shows a unique HB morphology, and the third (NGC 6864) is a moderately metal-rich object with an unusually large population of HB stars relative to the giant-branch stars. The second object, NGC 5694, has long been known as a possible "intergalactic" cluster that may be escaping from the Galaxy. The information discussed here indicates that NGC 5694 may be gravitationally bound to the Galaxy if the galactic halo within ~25 kpc is slightly more massive than in conventional models. Finally, NGC 7089 (M2) is shown to have characteristics that modify earlier conclusions from Arp's classical (m_{pg}, m_{pv}) photometry. (auth)

26973 ABSORPTION AND DEFOCUSING OF ELECTROMAGNETIC RADIATION BY A SCHWARZSCHILD BLACK HOLE. Haxton, W. (Institute of Theoretical Physics, Stanford University, Stanford, California 94305); Ruffini, R. Ann. Phys. (N.Y.) 95: No. 1, 1-9 (Nov 1975).

A comparison of electromagnetic radiation absorbed by a black hole and that emitted at infinity is made for selected circular orbits of a charged particle in a Schwarzschild geometry. Radiation intensity and beaming processes for geodesic as well as ultra-relativistic unbound orbits are compared and constrasted with the special relativistic results of classical electrodynamics. (auth)

26974 OPTICAL OBSERVATIONS OF THE RECURRENT NOVA ASSOCIATED WITH A0620-00: 1917-1975. Eachus, L.J.; Wright, E.L.; Liller, W. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 203: No. 1, L17-L19 (1 Jan 1976).

A previous outburst of the eruptive star associated with the transient X-ray source A0620-00, first detected in 1975 August, has been discovered on Harvard plates taken in 1917. We present the light curve of the earlier event and conclude that this star is a typical recurrent nova with an absolute magnitude $M_V = -5.9 \pm 0.5$ at maximum brightness. The A0620-00 star has no detectable proper motion, and there appears to be little interstellar absorption. Our best estimate of its distance is 11±3 kpc. A0620-00 is only 30°.6 from the direction of the galactic anticenter and therefore must be located well beyond the detectable limits of our Galaxy. (auth)

26975 A POSSIBLE MAGNETIC DA WHITE DWARF. Wickramasinghe, D.T.; Bessell, M.S. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. Lett. 203: No. 1, L39-L41 (1 Jan 1976).

The spectrum of a peculiar southern white dwarf suspect BPM 25114 is described. A possible magnetic interpretation suggests a DA white dwarf with a field of about 10^7 gauss. The star appears to be both a spectrum variable and perhaps light variable. (auth)

26976 H alpha AND H beta PHOTOELECTRIC PHOTOMETRY OF BRIGHT Be STARS. Baliunas, S. L.; Ciccone, M. A.; Guinan, E. F. Publ. Astron. Soc. Pac.; 87: No. 520, 969-974(Dec 1975).

H alpha and H beta photoelectric observations of 33 early-type standard stars and 23 Be stars were obtained at the Villanova University Observatory on 27 nights between January 1972 and February 1973. The data permit separation of the stronger-lined Be stars from the normal stars and reveal variations in the Be star gamma Cas. When compared with earlier data obtained by others, the Villanova data show longer-term variations in five other Be stars as well: omega Ori, zeta Tau, kappa Dra, 23 Tau, and psi Per. (auth)

26977 DISCOVERY OF MAGNETIC FIELDS IN FOUR SOUTHERN AP STARS. Borra, E. F.; Landstreet, J. D. Publ. Astron. Soc. Pac.; 87: No. 520, 961-963(Dec 1975).

A search for magnetic fields in southern Ap stars has been made using a Balmer-line magnetograph. Observations of nine stars were obtained, and definite or probable evidence for the presence of fields ranging from a few hundred gauss to almost four kilogauss was found in HD 54118, HD 94660, HD 133880, and alpha Cir. (auth)

26978 WHAT STARS BECOME SUPERNOVAE. Tinsley, B. M. (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac.; 87: No. 520, 837-848(Dec 1975).

A variety of empirical lines of evidence is assembled on the masses and stellar population types of stars that trigger supernova (SN) explosions. The main theoretical motivations are to determine whether type I supernovae (SN I) can have massive precursors, and whether there is an interval of stellar mass, between the masses of precursors of pulsars and white dwarfs, that is disrupted by carbon detonation. Statistical and other uncertainties in the empirical arguments are given particular attention, and are found to be more important than generally realized. Relatively secure conclusions include the following. Statistics of stellar birthrates, SN, pulsars, and SN remnants in the Galaxy show that SN II (or all SN) could arise from stars with masses greater than M/sub s/ where M/sub s/ approximately 49 to 12 solar mass; the precursor mass range cannot be more closely defined from present data; nor can it be said whether all SN leave pulsars and/or extended radio remnants. Several methods of estimating the masses of stars that become white dwarfs are consistent with a lower limit, M/sub s/ greater than or equal to 5 solar mass, so carbon detonation may indeed be avoided, although this conclusion is not secure. Studies of the properties of galaxies in which SN occur, and their distributions within galaxies, support the usual views that SN I have low-mass precursors (less than or equal to 5 solar mass and typically less than or equal to 1 solar mass) and SN II have massive precursors (greater than or equal to 5 solar mass); the restriction of known SN II to Sc and Sb galaxies, to date, is shown to be consistent, statistically, with massive stars in other galaxies also dying as SN II. Possible implications of the peculiarities of some SN-producing galaxies are discussed. Suggestions are made for observational and theoretical studies that would help answer important remaining questions on the nature of SN precursors. (auth)

26979 SPECTRAL TYPES IN THE OPEN CLUSTER IC 4665. Abt, H. A.; Levato, H. (Kitt Peak National Observatory, Tucson). Publ. Astron. Soc. Pac.; 87: No. 520, 849-851(Dec 1975).

Spectral types for 18 bright cluster members have been derived from spectra of several dispersions. Among the peculiar spectra are two B6 Vp stars with enhanced C II, one Hg-Mn Ap star, a shell star, and a classical Am star. (auth)

26980 OBSERVATION AND ANALYSIS OF STELLAR PHOTOSPHERES. Gray, D. F. New York; John Wiley and Sons, Inc. (1976). 483p.

Emphasis is placed on the observational aspects of stellar atmospheres. Following a review of Fourier transforms, spectroscopic instruments and light detectors are discussed. Other areas covered include radiation transfer, a model photosphere, and theoretical and observational aspects of stellar spectra. (BJG)

26981 $^{12}C/^{13}C$ RATIO IN THE CLASSICAL CEPHEID T MONOCEROTIS. Loumos, G. L.; Lambert, D. L.; Tomkin, J. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 87: No. 520, 859-861(Dec 1975).

Observations of the CN lines at 8000 A in the classical cepheid T Mon near minimum light are discussed. Weak ^{13}CN features are identified and an abundance ratio $^{12}C/^{13}C$ equals 9 +- 3 is derived. Similar observations for two other cepheids show no detectable ^{13}CN lines; the corresponding limits are $^{12}C/^{13}C$ greater than 17 (zeta Gem) and greater than 12 (eta Aql). (auth)

26982 ECLIPSING BINARIES FOUND SPECTROSCOPICALLY. II. HD 128141. Bond, H. E. Publ. Astron. Soc. Pac.; 87: No. 520, 877-878(Dec 1975).

The ninth-magnitude G-type star HD 128141 was noted to have diffuse spectral lines on an objective-prism plate. Photometric observations show this object to be an eclipsing binary of the W U Ma type, with a period of 0.355d. (auth)

26983 ORBIT OF THE BY DRACONIS VARIABLE ADS 16557B. Bopp, B. W. (Univ. of Toledo); Fekel, F. Jr. Publ. Astron. Soc. Pac.; 87: No. 520, 891-894(Dec 1975).

The BY Draconis-type variable ADS 16557B (HD 218738) is shown to be a double-line spectroscopic binary consisting of two nearly identical K2 dwarfs. The period is 3.03287 days. The system is a prime candidate for photometric spot modeling. (auth)

26984 EFFECTS OF UNRESOLVED DUPLICITY ON SPECTRA OF SOLAR-TYPE STARS. Bettis, C.; Branch, D. Publ. Astron. Soc. Pac.; 87: No. 520, 895-899(Dec 1975).

Equivalent widths of selected lines in composite spectra of normal main-sequence stars are calculated. The Na D lines are significantly stronger in many composite spectra than in spectra of single stars of similar color. As a rule, Fe I lines are slightly weaker and Fe II lines are slightly stronger in composite spectra. Effects on spectroscopic determinations of abundance ratios and surface gravities are discussed. It is suggested that spectrophotometric detection of relatively faint companions of solar-type stars is possible. (auth)

26985 PHOTOMETRIC ANALYSIS OF THE SUPERGIANT CLOSE BINARY, V453 SCORPII. Woodward, E. J. (William Paterson Coll. of New Jersey, Wayne); Koch, R. H. Publ. Astron. Soc. Pac.; 87: No. 520, 901-907(Dec 1975).

New yellow and blue photometry of V453 Sco shows the character of the light curve to be completely different from that accepted from photographic estimates. In the new data there are conspicuous photometric complications but it has been possible to solve the light curves by synthesis procedures. Absolute dimensions for the component stars have been derived and an attempt at understanding the systemic evolution is presented. (auth)

26986 PHOTOELECTRIC OBSERVATIONS OF RZ CASSIOPEIAE. Karle, J. H.; Vaucher, C.; Gaston, B. Publ. Astron. Soc. Pac.; 87: No. 520, 909(Dec 1975).

Photoelectric observations for a single night are presented, resulting in a well-observed time of primary minimum light for the eclipsing binary RZ Cas. (auth)

26987 INFRARED SPECTRUM OF ETA CARINAE: 3-14 MICRONS. Joyce, R. R. (State Univ. of New York, Stony Brook). Publ. Astron. Soc. Pac.; 87: No. 520, 917-921(Dec 1975).

Intermediate resolution spectral scans of eta Car in the range 3.2-14 mu m provide strong support for the model proposed by Robinson, Hyland, and Thomas (1973) in which the infrared emission arises from two concentric dust shells heated by the central object. No fine-structure or recombination emission lines were observed over this spectral range. (auth)

26988 PHOTOMETRIC OBSERVATIONS OF V470 CYGNI (HD 228911). Ebbighausen, E. G.; Lester, D.; Stearns, S.; Straton, P.; Sykes, M. Publ. Astron. Soc. Pac.; 87: No. 520, 923-927(Dec 1975).

Previous photometric observations of this type B2 spectroscopic binary with a 1.87d period have shown small but not well-defined light variations suggesting that it is an eclipsing binary with a rather small orbital inclination. In the summer of 1974 the authors obtained photoelectrically 2060 individual V observations and 2100 B observations of V470 Cygni at the Pine Mountain Observatory of the University of Oregon. The total light range in both colors is nearly 0.02m and the form of the light curve suggests that this object is an ellipsoidal binary. A new epoch of primary minimum and period are derived. All of the data combined are insufficient to confirm Pearce's suggestion of apsidal motion. (auth)

26989 COMPOSITE NATURE OF THE F SUPERGIANT CD-30°5135. Humphreys, R. M. Publ. Astron. Soc. Pac.; 87: No. 520, 933-934(Dec 1975).

CD-30°5135 has a composite spectrum consisting of an F-type supergiant and a late B-type star (F2ep Iab + B8:). The velocity data confirm that it is a double-line spectroscopic binary. P Cygni emission profiles are present at H gamma and H delta. (auth)

26990 INFRARED STAR IN RCW 113. Danks, A. C. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 87: No. 520, 941-942(Dec 1975).

Photometric observations of an infrared star in the H, K, and L bands are presented. The star was detected by drift scans of the H II region RCW 113 at 2.37 mu. (auth)

26991 REGION OF NOVA CYGNI 1975 ON THE PALOMAR SKY SURVEY. Beardsley, W. R.; King, M. W.; Russel, J. L.; Stein, J. W. Publ. Astron. Soc. Pac.; 87: No. 520, 943-944(Dec 1975).

Careful superposition of a blue Palomar Sky Survey print onto a sectored photograph of Nova Cygni 1975 obtained with the Thaw 30-inch (76-cm) refractor at the Allegheny Observatory decisively confirms the fact that no star brighter than magnitude 21 appears on the Sky Survey print at that position. (auth)

26992 PHENOMENON OF GAMMA-RAY BURSTS AND COS-B. Taylor, B. G. (European Space Research and Tech. Center, Noordwijk, Netherlands). ESRO/ELDO Bull.; 24-26(Jul 1974).

Recent reports of gamma-ray bursts of cosmic ray origin, recorded by four Vela satellites during the past six years or so, have given rise to considerable speculation as to the cause and origin of the bursts. To add to the observational data available, the COS-B satellite, scheduled for launch in the spring of 1975, has been adapted to the study of such bursts by the addition of two small electronics units, which will provide information on their position and fine temporal structure. (auth)

26993 PARTICLE CREATION BY BLACK HOLES. Hawking, S. W. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Commun. Math. Phys.; 43: No. 3, 199-220(1975).

5 figs.; 30 refs.

In the classical theory black holes can only absorb and not emit particles. However it is shown that quantum mechanical effects cause black holes to create and emit particles. This thermal emission leads to a slow decrease in the mass of the black hole and to its eventual disappearance: any primordial black hole of mass less than about 10^{15}g would have evaporated by now. Although these quantum effects violate the classical law that the area of the event horizon of a black hole cannot decrease, there remains a Generalized Second Law: $S + \frac{1}{4} A$ never decreases where S is the entropy of matter outside black holes and A is the sum of the surface areas of the event horizons. This shows that gravitational collapse converts the baryons and leptons in the collapsing body into entropy. It is tempting to speculate that this might be the reason why the Universe contains so much entropy per baryon. (DE)

26994 HIGH RESOLUTION MEASUREMENTS OF THE SUPERNOVA HB 21 AT A FREQUENCY OF 2.7 GHz. Haslam, C. G. T.; Keen, N. J.; Wilson, W. E.; Graham, D. A.; Thomasson, P. (Max-Planck-Institut fuer Radioastronomie, Bonn (F. R. Germany)). Astron. Astrophys.; 39: No. 2, 453-454(Mar 1975).

2 figs.; 5 refs.

Total brightness temperature measurements of HB 21 at 2.7 GHz show a structure very similar to that reported by Hill at 1.4 GHz at similar angular resolution. The spectral index over large parts of the source is ~2.8. (DE)

26995 MAGNETIZED FERMI GAS IN THE OUTER SHELL OF NEUTRON STARS. Fu, K. Y. (National Taiwan Univ., Taipei). Chin. J. Phys. (Taiwan); 13: No. 2, 183-187(Oct 1975).

The stress anisotropy and the degenerate behaviors of a magnetized Fermi gas in the outer shell of neutron stars were investigated. The main purpose of this investigation is to study the influence of the magnetized Fermi gas on the equilibrium structure of neutron stars during their cooling process. In the approximation of degeneracy limit, the normal stresses have discontinuous derivatives with respect to the chemical potential, and the chemical potential decreases as the temperature approaches zero. These results demonstrate either a rapid decrease of the pressure or a discontinuity of the pressure gradient in the outer shell of neutron stars as they are cooling down. This leads one to propose that the starquake, which is adopted to account for the pulsar "glitches," can be triggered in the outer shell of neutron stars. For this triggering process to be effective, one needs a magnetic field of strength $\geq 10^{14}$ gauss for the Vela ones. (auth)

26996 THOMAS–FERMI NUCLEI IN NEUTRON STAR MATTER. Csernai, L. P. (Univ. of Technical Sciences, Budapest); Kisdi, D.; Nemeth, J. Acta Phys. Acad. Sci. Hung.; No. 2, 89-108(1975).

The nuclear structure of zero temperature neutron star matter is investigated in the density region $\rho = 10^{11} - 10^{14}$ g/cm^3. The energy of a nucleus embedded into a nucleon liquid is calculated in the Thomas–Fermi approximation. We find that the beginning of the neutron drip is a first order transition of phase at the critical pressure $P = 2.0 \times 10^{30}$ dyn/cm^2. The resulting equation of state is compared with previous predictions and the inside structure of neutron stars are determined by integrating the Oppenheimer–Volkoff equations. (auth)

26997 TWO-PARAMETER PRESENTATIONS OF LIMB DARKENING LAWS FOR CLASSIC STARS. Rubashevskii, A. A. (Kiev Planetarium). Astrometriya Astrofiz.; No. 27, 94-104 (1975). (In Russian).

Two-parameter presentations of the limb darkening law were analysed with the purpose to find the best approximation of the brightness distribution on the star's disk provided the total radiation flux. An approximation of laws of limb darkening by two straight lines is considered. The calculations show that detection of the effects due to non-linearity of the limb darkening leads to more reassuring results than those obtained in previous investigations. 10 refs., 4 tables (auth)

26998 STELLAR VARIABILITY IN Aql. Shaganyan, B. L. (Kherson Pedagogical Inst., USSR). Astrometriya Astrofiz.; No. 27, 105-112(1975). (In Russian).

The work is a part of the study of all variables in the vicinity of galactic cluster NGC 6830. Photographic magnitudes of NV, V467 and V700 Aql are given. For NVAql the period of mean light variation (P = 1000 days) was specified and Beyler's elements were confirmed. The period of light variation of V467 Aql in photographic region close to 55 days and the period of slow oscillations equal to 1400 days were found. V467 Aql was shown to belong to semi-regular variables of the μ Cephei type. The probable period of light variation of V700 Aql in photographic region equals to 54 days. The resulting form of each variable, photographic magnitudes of comparison stars and the epochs of light maxima are given. 9 refs., 6 figs., 6 tables (auth)

26999 ENERGY DISTRIBUTION IN SPECTRA OF 15 STARS OF SPECTRAL CLASSES O, B, A. Komarov, N. S.; Depenchuk, E. A.; Chuprina, R. I. (Astronomical Observatory, Odessa). Astrometriya Astrofiz.; No. 27, 113-118(1975). (In Russian).

Energy distribution E_λ in 15 stars in the spectral region from 3200 to 7750 Å was calculated by observations obtained with the Seya–Namioka spectrometer attached to the AZT-14 reflector at the Terskol station and with AZT-3 reflector at the Mayaki station. The technique used was described in Part I of the paper. Values of E_λ are given in absolute units (erg. cm^2 sec). 1 ref., 2 tables (auth)

27000 INVESTIGATIONS OF THE MAGNETIC Ap-STARS 53 CAM AND GAMMA EQU. Scholz, G. (Astrofizikalisches Observatorium, Potsdam, Ger.). Astron. Nachr.; 296: No. 1, 31-39(1975). (In German).

A number of Zeeman spectrograms for both stars were examined in connection with a study of the stellar magnetic field characteristics, the radial velocity, and the periodic properties of the two stars. The results of radial velocity measurements for the individual elements are presented in a graph as a function of the phase. In the case of 53 Cam the data confirm the existence of a spectrum variation already reported by Babcock (1958). It is found that different elements have different radial velocities. The possible significance of this phenomenon is considered. A spectrum variation could not be detected for gamma Equ. (IAA)

27001 INERTIAL AND THE HEAVY MASS OF A CELESTIAL BODY ACCORDING TO INERTIALESS DYNAMICS AND THE SELF-ABSORPTION OF THE GRAVITATIONAL FORCE. Treder, H. J. (Deutsche Akademie der Wissenschaften, Sternwarte, Ger.). Astron. Nachr.; 296: No. 1, 9-13(1975). (In German).

In the inertialess dynamics considered by Treder (1972), the effective inertial masses of particles are homogeneous functions of the external Newtonian gravitational potential. It is shown that on the basis of these considerations the sum of the effective inertial masses of the particles of a star is always greater than the entire stellar mass. The actual gravitational accelerations of the particles in the stellar interior are always smaller than the accelerations which would be obtained in a computation according to Newtonian principles. The results are compared with the effect of the self-absorption of gravitation according to a theory of gravitation described by Treder (1971). (IAA)

27002 NEUTRON STARS IN X-RAY SOURCES. Mechanisms for Evolution of Binary Systems. Schatzman, E. (Observatoire de Paris, Meudon, France). Phys. Bull. (London); 26: 484-488 (Nov 1975).

This article is based on the 1975 Holweck Prize lecture delivered by Professor Schatzmann in which he discussed mechanisms for the evolution of binary systems. The properties of white dwarfs, which should be more properly referred to as "degenerate stars," are related to the recent discovery of variable x ray sources which are binary stars consisting of a bright star and a neutron star. A large fraction of the degenerate star exists in the form of binary systems. Different evolutionary tracks of degenerate stars are explored from which it is deduced that the one resulting in pulsating x ray sources could well be the least probable explaining their small numbers. (UK)

27003 GRID OF MODEL ATMOSPHERES FOR METAL-DEFICIENT GIANT STARS. II. Bell, R. A. (Univ. of Maryland, College Park); Eriksson, K.; Gustafsson, B.; Nordlund, A. Astron. Astrophys., Suppl. Ser.; 23: No. 1, 37-95(Jan 1976).

The details of a grid of flux-constant model atmospheres, described in a previous paper, are given. The grid covers the general range $3750\ K \leq T_{eff} \leq 6000\ K$, $0.75 \leq \log g \leq 3.0$, $-3.0 \leq [A/H] \leq 0.0$. Line blanketing due to metal lines and molecular lines is considered in great detail. Convection is treated in the mixing-length approximation. A solar model, consistent with the rest of the models, is also presented. (auth)

27004 THREE COLOR PHOTOMETRY OF A FIELD IN THE GALACTIC ANTICENTER SECTION NEAR M37. Becker, W. (Univ., Basel); Svolopoulos, S. Astron. Astrophys., Suppl. Ser.; 23: No. 1, 97-107(Jan 1976).

As part of a program to investigate the stellar content of the galactic anticenter direction, RGU photometry (on plates of the 48'' Palomar Schmidt) was carried out for a star field near M37; its size is 0.18□° and it contains 1234 measurable stars. The interstellar reddening in this direction is caused by two absorbing clouds, one lying between 200 and 400 pc, the other one at 2.5 kpc. Their combined color excess is E(G–R) = 0.64m. The density of late giants as well as of main sequence stars with $0m \leq M(G) < 2m$ decreases with distance, reaching at a distance of 10 kpc $^1/_{175}$ of the value for the solar neighborhood. Allowing for the scatter of the absolute magnitude of giants by Monte Carlo methods leads to space densities somewhat smaller than the observed ones only in distances >9 kpc. The gradients of the density function for main sequence stars with $2m \leq M(G) < 7m$ are also negative. Extrapolating these gradients for nearby volumes gives densities which agree well with those derived for the solar neighborhood from Gliese's catalogue. The luminosity functions for three distance intervals (0.5–1.5; 1.5–2.0; 2.0–3.0 kpc) cover a magnitude range of $0m < M(G) < 6m$. The slope of their gradients is similar to the slope of the gradients of the luminosity function for the solar neighborhood. (auth)

27005 OPTICAL POLARIZATION OF STARS OF GALACTIC LATITUDES $b < -45°$. Schroeder, R. (Observatory, Hamburg). Astron. Astrophys., Suppl. Ser.; 23: No. 1, 125-137(Jan 1976).

Optical polarization data of about 500 stars of galactic latitudes $b < -45°$ are represented in the following catalogue. The instrumentation is specified and the method of data reduction is described.

27006 EXTREMAL STATES OF MATTER IN ASTROPHYSICS. Part II. Superfluidity and Superconductivity: Astrophysical Aspects. Borczuch, M. S. (Instytut Fizyki Politechniki, Warsaw); Kuchowicz, B. Postepy Astron.; 23: No. 3, 177-197(1975). (In Polish).

After a brief discussion of the temperature-density regions in which various kinds of equations of state are relevant, the question of the search for possible extremal states of matter under natural conditions is asked. The possibilities of an appearance of the superfluid and superconducting states of matter in celestial objects (dense plasma in white dwarfs and planets, neutron matter and superconducting protons in pulsar cores) are reviewed. (auth)

27007 NEUTRON STARS. Baym, G.; Pethick, C. (Univ. of Illinois, Urbana). Annu. Rev. Nucl. Sci.; 25: 27-77(1975).

Recent developments in the understanding of the properties of condensed matter at high densities and their implications for the structure of neutron stars are reviewed. Topics include nuclear physics of the crust, neutron star interiors, transport properties, and neutron star models. 231 references. (BJG)

27008 T TAURI STARS. Rydgren, A. E. Jr. Tucson, AZ; Univ. of Arizona (1975). 167p. University Microfilms Order No. 76-3798.

Thesis (Ph. D.).

Homogeneous spectroscopic and photometric (optical and infrared) observations of 49 T Tauri stars in the Taurus and Rho Oph clouds are presented; these data form the basis for a study of their envelope properties and evolutionary state. This analysis shows that the T Tauri phenomenon is best understood in terms of a model in which a late-type star is surrounded by a hot gaseous envelope. Emission from the envelope accounts for the emission lines, the spectral veiling, and most of the true infrared excess, while temporal changes in the strength of the envelope emission appear to be the principal source of irregular light variations. Some T Tauri stars show silicate emission features at 10 and 20 mu, but emission from circumstellar dust at wavelengths shortward of 10 mu is shown to be insignificant in most cases. Proper understanding of the envelope emission processes enables us to correct the observed spectral energy distributions for interstellar extinction and thus obtain reliable bolometric luminosities. These luminosities, together with effective temperatures derived from the photospheric spectral types, indicate that the T Tauri stars in these two clouds are relatively low mass stars evolving toward the main sequence along quasi-static equilibrium tracks. Evidence is presented which indicates that the mass-loss rate and envelope emission strength decrease with time during the T Tauri phase. It is suggested that the T Tauri phenomenon corresponds to a phase of rapid angular momentum loss in convective protostars. (Diss. Abstr. Int., B)

27009 RADIOASTRONOMICAL OBSERVATIONS OF UV CETI STARS. Spangler, S. R. Iowa City, IA; Univ. of Iowa (1975). 156p. University Microfilms Order No. 76-2186.

Thesis (Ph. D.).

The UV Ceti-type stars V371 Ori, YZ CMi, AD Leo, Wolf 424, BD + 16^{0}2708, Ross 867, G25-16, EQ Peg, and G3-33 were monitored at the Arecibo Observatory for more than 400 hours in the time period October 20, 1973 to August 5, 1974. The decimetric wavelength observations may be categorized as radiometry, polarimetry, simultaneous optical-radio observations, and a search for long time scale variations. More than 70 flare events were observed during the project. There appear to be two classes of events based on flare duration: Impulsive events with half power durations ranging from a few seconds to 1 or 2 min. Longer duration flares with half power durations of 10 min or longer. This latter class of flare has been previously observed by Lovell (1971) and Higgins et al. (1968). Observed amplitudes for both classes of events at 430 MHz ranged from the detection limit of a few hundredths of a flux unit to 0.6 flux units. Rates of occurrence of impulsive events are comparable to optical detection rates. Spectral indices derived from simultaneous observations at 318 and 196 MHz tend to be strongly nonthermal with a range of -1.3 to -7.2. Results of four Stokes parameter polarimetry at 430 MHz show a wide variety of polarization states. The bulk of the observations, however, were compatible with a total polarization of about 60 percent. During a period of joint optical-radio monitoring of the stars YZ Canis Minoris, AD Leonis, and Wolf 424, 62 optical flares were detected, and 13 radio frequency events were independently identified, of which 10 reached maximum flux within 10 min of the peak time of an optical flare. (Diss. Abstr. Int., B)

27010 STABILITY OF CONGRUENT DARWIN ELLIPSOIDS. Tassoul, M. (Univ. of Montreal). Astrophys. J.; 202: No. 3, 803-808(15 Dec 1975).

The problem of synchronous oscillations of congruent Darwin ellipsoids is reconsidered. Contrary to results obtained by Chandrasekhar, it is shown that along a Darwin sequence the configurations remain stable with respect to ellipsoidal disturbances until they become too closely spaced. The precise limit which separates stable from unstable systems is found. Apart from some minor differences the Darwin sequence is the exact analog of the Roche sequence. (auth)

27011 COUPLED SECOND-HARMONIC OSCILLATIONS OF THE CONGRUENT DARWIN ELLIPSOIDS. Chandrasekhar, S. (Univ. of Chicago). 202: No. 3, 809-814(15 Dec 1975).

A general theory of coupled second-harmonic oscillations of the congruent Darwin ellipsoids is developed. The class of oscillations studied includes the synchronous oscillations as a special degenerate case. (auth)

27012 SEVENTH TEXAS SYMPOSIUM ON RELATIVISTIC ASTROPHYSICS. Weidemann, V. (Univ., Kiel). Earth Extraterr. Sci.; 2: No. 6, 189-198(1975).

Papers are presented on the following topics: observational cosmology, supernovae, pulsars, neutron stars, binary x-ray sources, black holes, gamma ray bursts, neutrino astrophysics, quasars and radio galaxies, general relativity and cosmology, and observational tests of general relativity. (BJG)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 26965, 26974, 27002, 27012, 27069, 27075, 27161, and 27176.

27013 (AD/A-005409) TIME DEPENDENCE OF THE INTEGRATED STOKES PARAMETERS OF COMPACT RADIO SOURCES AT 5 GHz. Seielstad, G. A.; Berge, G. L. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1975. 46p. NTIS $3.75.

The integrated 5 GHz radio emission, including the complete polarization state as well as the flux density, of 15 compact radio sources was monitored for a period of 27 months. In the data presented, there are several examples of interesting time variations. However, the diverse behavior and other properties of the sources defy any satisfactory generalizations regarding mechanisms. (GRA)

27014 (AD/A-005769) OBSERVATIONS WITH A VLB ARRAY. The Sources 3C120, 3C273, 2134 + 004, AND 3C84. III. Schilizzi, R. T.; Cohen, M. H.; Romney, J. D.; Shaffer, D. B.; Kellermann, K. I. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1975. Contract N00014-67-A-0019. 48p. NTIS $3.25.

Sponsored in part by Grants NSF-GP-19400, NSF-GP-8115. Prepared in cooperation with Yale Univ., New Haven, Conn. Observatory. National Radio Astronomy Observatory, Green Bank, W. Va. Illinois Univ., Urbana. Toronto Univ. (Ontario).

The sources 3C120, 3C273, 2134 + 004 and 3C84 were observed at several epochs at 2.8 cm by using a multi-element very-long-baseline interferometer. The resulting visibility data show that the brightness distributions of each source are variable. There are large changes in the visibilities of 3C120 and 3C273 on a time scale of months. For 3C120, and perhaps 3C273, the changes can be explained by source distributions in which the components are separating at high (probably relativistic) speeds. (GRA)

27015 (AD/A-006637) OBSERVATIONS WITH A VLB ARRAY. II. The Sources 4C39.25, NRAO150, VRO42.11.01, 3C345, and 3C454.3. Shaffer, D. B.; Cohen, M. H.; Romney, J. D.; Schilizzi, R. T.; Kellermann, K. I. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1975. Contract N00014-67-A-0094-0019. 24p. NTIS $3.25.

See also AD/A-004641. Prepared in cooperation with National Radio Astronomy Observatory, Green Bank, W. Va., Yale Univ., New Haven, Conn. Observatory, Toronto Univ. (Ontario), and Harvard Radio Astronomy Station, Fort Davis, Tex. Grant NSF-GP-8115.

Three-antenna long baseline interferometry at 10.7 GHz is reported for NRAO150, 4C39.25, 3C345, VRO42.22.01, and 3C454.3 for several epochs between April, 1972 and February, 1974. Simple models for the source brightness distributions fit the observations and indicate that most of the radio emission comes from one or two components. Component separations range up to approximately 50 light years, and component sizes are on the order of 10 light years. Small variations in source structure have been observed. (GRA)

27016 (MPI-PAE/ASTRO-64) EXPANDING QUASAR ENVELOPES. Pt. 1. Steady Radiation-Driven Winds. Kippenhahn, R.; Mestel, L.; Perry, J. J. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Jul 1975. 50p. INIS.

9 figs.; 1 tab.; 8 refs. Available from ZAED.

Spherically symmetric expanding envelopes have been investigated which are in ionization and thermal equilibrium in non-thermal radiation field of a QSO, and which are accelerated by momentum absorption from this radiation field as well as by the thermal pressure gradient and gravity. The winds are parameterized by the luminosity to mass ratio and by the fractional mass loss rate. A maximum permitted value for this mass loss rate exists beyond which no winds with subsonic branches above the QSO surface can exist. (DE)

27017 TIMING OF THE CRAB PULSAR. I. ARRIVAL TIMES. Groth, E.J. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. Suppl. Ser. 29: No. 293, 431-442 (Nov 1975).

This paper presents the pulse arrival times obtained during five years of observation of the Crab Nebula pulsar, PSR 0531+21. The reduction from topocentric to barycentric arrival times and errors affecting the results are discussed. Subsequent papers in this series will use these data to determine the time dependence of the pulse frequency. (auth)

27018 TIMING OF THE CRAB PULSAR. II. METHOD OF ANALYSIS. Groth, E.J. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. Suppl. Ser. 29: No. 293, 443-451 (Nov 1975).

This paper presents a new method of analysis especially designed for time series such as the Crab pulsar timing data. These data reflect a random process superposed on a smooth behavior described by a low-degree polynominal. In addition, the measurements are not equally spaced and not of uniform quality. With such data, conventional power-spectrum or autocorrelation function techniques cannot be used to study the random process, nor can conventional regression techniques be used to study the polynomial behavior. Even in the ideal case of uniformly spaced, uniform quality data, containing only the random process and no polynomial, power-spectrum techniques would be of limited utility, as the random process is most probably nonstationary. The method described here allows a relatively clean separation of the polynomial and random components so that each may be studied without interference from the other. Also, the method is not compromised by the fact that the random component is nonstationary. The method makes use of the second moments of the data and is related to power-spectrum techniques. (auth)

27019 TIMING OF THE CRAB PULSAR III. THE SLOWING DOWN AND THE NATURE OF THE RANDOM PROCESS. Groth, E.J. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. Suppl. Ser. 29: No. 293, 453-465 (Nov 1975).

The Crab pulsar arrival times are analyzed. The data are found to be consistent with a smooth slowing down with a braking index of 2.515 ± 0.005. Superposed on the smooth slowdown is a random process which has the same second moments as a random walk in the frequency. The strength of the random process is $R\langle \delta\nu^2 \rangle = 0.53\ (+0.24, -0.12) \times 10^{-22}$ Hz^2 s^{-1}, where R is the mean rate of steps and $\langle \delta\nu^2 \rangle$ is the second moment of the step amplitude distribution. Neither the braking index nor the strength of the random process show evidence of statistically significant time variations, although small fluctuations in the braking index and rather large fluctuations in the noise strength cannot be ruled out. There is a possibility that the random process contains a small component with the same second moments as a random walk in the phase. If so, a time scale of 3.5 days is indicated. (auth)

27020 THE RICHTMYER MEMORIAL LECTURE: PROGRESS IN X—RAY ASTRONOMY. Giacconi, R. (Center for Astrophysics, Harvard University/Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138). Am. J. Phys. 44: No. 2, 121-134 (Feb 1976).

Response of the Richtmyer Memorial Lecturer to the American Association of Physics Teachers, 30 January 1975, at Anaheim, California. (auth)

27021 RELATIVISTIC FORMULATION OF THE NEUTRON STARQUAKE THEORY OF PULSAR GLITCHES. Carter, B. (Observatoire de Paris-Meudon, France); Quintana, H. Ann. Phys. (N.Y.) 95: No. 1, 74-89 (Nov 1975).

This work provides the framework for analyzing the Neutron starquake theory of pulsar glitches in terms of the exact Einstein theory of gravity and relativistic elasticity theory, subject to the assumption that the neutron star is axisymmetric and slowly rotating. Since general relativistic effects are important in the larger neutron star models, such investigations might eventually lead to an observational test of Einstein theory under strong gravitational field conditions. (auth)

27022 THE REDSHIFT OF 0938+119. Beaver, E.A.; Harms, R. (Physics Department, University of California, San Diego); Hazard, C.; Murdoch, H.S.; Carswell, R.F.; Strittmatter, P.A. Astrophys. J. Lett. 203: No. 1, L5-L8 (1 Jan 1976).

Digicon observations of the Molonglo radio source 0938+119, originally classified as a faint radio galaxy, show it to be a QSO with a redshift $z=3.19$ and a spectrum similar to that of OH 471. (auth)

27023 X—RAY NOVA A0620-00: CELESTIAL POSITION AND LOW-ENERGY FLUX. Doxsey, R.; Jernigan, G.; Hearn, D.; Bradt, H.; Buff, J.; Clark, G.W.; Delvaille, J.; Epstein, A.; Joss, P.C.; Matilsky, T.; Mayer, W.; McClintock, J.; Rappaport, S.; Richardson, J.; Schnopper, H. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. Lett. 203: No. 1, L9-L12 (1 Jan 1976).

The X-ray nova A0620-00 (Nova Monocerotis 1975) has been observed with the SAS-3 satellite. The 1–10 keV intensity was observed to increase by a factor of 2.3 from August 8 to August 11. It reached and maintained a constant intensity of 1.7×10^{-6} ergs cm^{-2} s^{-1} from August 11 to August 13. Limits on periodicities of $\lesssim 2$ percent of the power were obtained for periods from 0.2 ms to 435 s. A precise position was obtained with the SAS-3 modulation collimators on August 15. This led directly to optical and radio identifications. Observations with the SAS-3 low-energy concentrator system on August 27 showed an intense 0.4–0.8 keV flux emanating from the nova. A hydrogen column density of $(3.5 \pm 0.3) \times 10^{21}$ cm^{-2} was inferred from these data. (auth)

27024 OPTICAL IDENTIFICATION OF A0620-00. Boley, F.; Wolfson, R. (Department of Physics and Astronomy, Dartmouth College); Bradt, H.; Doxsey, R.; Jernigan, G.; Hiltner, W.A. Astrophys. J. Lett. 203: No. 1, L13-L14 (1 Jan 1976).

An identification of the optical object corresponding to the new, transient X-ray source A0620-00 has been made. The early spectra of the object show no emission or absorption features. (auth)

27025 RADIO EMISSION FROM THE X—RAY SOURCE A0620-00. Owen, F.N. (National Radio Astronomy Observatory, Green Bank, West Virginia); Balonek, T.J.; Dickey, J.; Terzian, Y.; Gottesman, S.T. Astrophys. J. Lett. 203: No. 1, L15-L16 (1 Jan 1976).

Observations are reported of radio emission from the transient X-ray source A0620-00. Data obtained over the period 1975 August 15 to August 22 at frequencies between 1400 and 2695 MHz indicate a decaying radio event. The radio event appears to be quite different from those associated with recent galactic novae and is difficult to reconcile with a standard thermal model. A nonthermal event similar to those associated with Cygnus X-3, however, is consistent with the observations. (auth)

27026 MX 1313+29: A COMPACT SOURCE OF VERY LOW ENERGY X-RAYS IN COMA BERENICES. Hearn, D.R.; Richardson, J.A.; Bradt, H.V.D.; Clark, G.W.; Lewin, W.H.G.; Mayer, W.F.; McClintock, J.E.; Primini, F.A.; Rappaport, S.A. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. Lett. 203: No. 1, L21-L24 (1 Jan 1976).

A compact X-ray source near the North Galactic pole has been detected with the low-energy X-ray telescope aboard the SAS-3 satellite. The position is α (1950.0) $= 13^h14^m0 \pm 0^m5$, δ (1950.0) $= +29°15' \pm 18'$. The spectral temperature of the source is less than 10^6 K, and the energy flux at the Earth is 3×10^{-10} ergs cm^{-2} s^{-1} above 0.1 keV. The flux appeared to be constant both on short time scales (10–1000 s), and over the interval from the first SAS-3 observation (1975 June 12) to the latest (1975 July 15). The possible identification of this source with the hot white dwarf HZ 43 is discussed. (auth)

27027 AN ULTRASOFT X—RAY SOURCE IN COMA BERENICES. Margon, B.; Malina, R.; Bowyer, S.; Cruddace, R.; Lampton, M. (Space Sciences Laboratory, University of California, Berkeley). Astrophys. J. Lett. 203: No. 1, L25-L28 (1 Jan 1976).

We have observed an intense soft X-ray source with an extraordinary spectrum in Coma Berenices, 4° northeast of and unassociated with the Coma cluster of galaxies. Two spectra, obtained at different times in a sounding rocket flight, indicate that the source temperature in thermal models is less than 10^6 K; a power-law model requires photon power-law indices steeper than $n = -3$. The intensity in the 44–165 A band is of the order of 5×10^{-10} ergs cm^{-2} s^{-1}, but no flux is present at energies 0.3–2.1 keV to a limit of 1×10^{-10} ergs cm^{-2} s^{-1}. The lack of bright stars or a supernova remnant in the error box implies that this may be a new class of soft X-ray sources. (auth)

27028 THE X—RAY BEHAVIOR OF 3U 1700-37. Mason, K.O.; Branduardi, G.; Sanford, P. (University College London, Mullard Space Science Laboratory, Holmbury St. Mary, Dorking, Surrey, England). Astrophys. J. Lett. 203: No. 1, L29-L33 (1 Jan 1976).

An observation with the *Copernicus* X-ray telescopes reveals two kinds of flux variability in 3U 1700-37. Fluctuations on a time scale of 1 hour are energy-independent in the 3.5–10.5 keV range, while changes of intensity with binary phase are caused by a variable absorbing column. We find that there is relatively more absorbing material in the line of sight following the passage of the X-ray source in front of its companion, but comparison with the light curve of Jones *et al.* indicates

that this must be a variable phenomenon. The length of eclipse during the present observation was significantly shorter than when observed by Jones *et al.* (auth)

27029 RADIO EMISSION FROM THE WOLF-RAYET BINARY γ^2 VELORUM. Seaquist, E.R. (Division of Radiophysics, CSIRO, Sydney, Australia). Astrophys. J. Lett. 203: No. 1, L35-L37 (1 Jan 1976).

We report the detection of radio emission from the Wolf-Rayet binary γ^2 Velorum at 5.00, 6.27, and 8.87 GHz. The data are combined with infrared measurements, and the results are interpreted as free-free emission from a circumstellar gas cloud extending to $r \gtrsim 10^{15}$ cm, much larger than the orbital radius of the binary. (auth)

27030 NEW OPTICAL IDENTIFICATIONS FROM THE ELEVENTH PART OF THE PARKES 2700 MHz SURVEY: DECLINATIONS −4° TO −30° RIGHT ASCENSIONS 22^h TO 05^h. Savage, A.; Wall, J. V. (Royal Greenwich Observatory, Hailsham, Eng.). Aust. J. Phys., Astrophys. Suppl.; No. 39, 39-68(Jan 1976).

Identifications are suggested for 166 radio sources from a survey of 0.8 sr about the south galactic pole, 88 with galaxies, 77 with quasi-stellar objects and one with a planetary nebula. The identifications were made from Palomar Sky Survey prints, supplemented in some cases with plates from the SRC 1.2 m Schmidt telescope and the 3.9 m Anglo–Australian telescope. (auth)

27031 PARKES 2700 MHz SURVEY. XI. Catalog for Declinations −4° to −30°. Right Ascensions 22^h to 05^h. Wall, J. V.; Wright, A. E.; Bolton, J. G. (CSIRO, New South Wales, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 39, 1-37(Jan 1976).

A catalogue of 819 radio sources is presented from a 2700 MHz survey of 0.79 sr about the south galactic pole. The catalogue is essentially complete for sources with $S_{2700} \geq 0.22$ Jy, corresponding to a source density of 850 sources per steradian. Flux densities were measured for many of the sources at 5009 MHz, including most of the sources with $S \geq 0.35$ Jy. The accuracy in both the 2700 and 5009 MHz flux densities is 0.02 Jy or 3%, whichever is the greater. Root-mean-square position errors are 10″ arc for sources stronger than 0.7 Jy, increasing to 25″ for the weakest sources in the catalogue. The catalogue includes the results of a search of the Palomar Sky Survey prints for identification data. (auth)

27032 POSITIONS FOR THE OPTICAL COUNTERPARTS OF SOME SOUTHERN RADIO SOURCES. Vander Haegen, J. (CSIRO, New South Wales, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 39, 69-71(Jan 1976).

Optical positions have been measured for 36 objects suggested as possible counterparts of radio sources near the south galactic pole. Twenty-nine of these are QSOs or possible QSOs, two are neutral stellar objects and the remainder galaxies. The positions are on the FK4 system and have typical errors of 0.5″ arc in right ascension and declination. (auth)

27033 RADIOGALAXIES AND LOCAL QUASARS. Terrell, J. (Los Alamos Scientific Lab., NM). Nature (London); 258: No. 5531, 132-133(13 Nov 1975).

Reference is made to some photographs obtained using the new 4 m telescope at Cerro Tololo Observatory, that showed filaments extending radially away from the galactic center and blue starlike images never previously seen near the Galaxy. The latter may be regarded as quasi-stellar objects. Such blue stars are presumably ejected from the galactic center and are predicted by the very local quasar model. They have been observed in the region of the north-east radio lobe of Centaurus A (NGC5128) at a distance of perhaps 80,000 light years from the center of that galaxy. If these blue stars are radio sources, as seems possible because of their location in the radio lobe, they could be producing radio emission by the same mechanism as postulated for very local quasars, that is, by relativistic motion through the gas and magnetic fields near the galaxy that ejected them. This would produce synchrotron radio emission of great strength and over a long period, drawing its power from the kinetic energy of the relativistically moving star. It would be of considerable interest to determine whether these blue objects are indeed radio sources, and fluctuations in optical and radio brightness would be expected if the objects are quasars local to Cen A. (UK)

Solar Phenomena

Refer also to abstracts 26959, 27091, 27093, 27116, 27130, and 27161.

27034 (AD/A-006125) STUDY OF THE THREE-CENTIMETER RADIO FREQUENCY EMANATION FROM THE SOLAR ATMOSPHERE. Interim Report. Grebenkemper, C. J. (Stanford Univ., Calif. (USA). Radio Astronomy Inst.). 29 Aug 1974. Contract F19628-74-C-0053. 20p. NTIS $3.25.

Two-dimensional radio contour maps were made of McMath Regions 12397 and 12417 at a wavelength of 2.8 centimeters. On 3 July 1973, Region 12417 was found to have a radio diameter of 15 arc-seconds and a true radio brightness temperature of 5 million K. The thermal bremsstrahlung and gyro-resonance emission mechanisms for the 2.8 centimeter slowly-varying component are discussed; the gyro-resonance emission is apparently dominant. The link between the high radio temperatures and solar flares is not clear, but the only regions to exhibit solar activity also had radio temperatures in excess of 5 million K. (GRA)

27035 (BMFT-FB-W-75-18) WAVES IN THE SOLAR WIND AND THEIR DOPPLERSHIFT IN THE FREQUENCY RANGE OF THE HELIOS-SEARCH-COIL-EXPERIMENT E4. Denskat, K. U. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). Sep 1975. 138p. (In German). INIS.

47 figs.; 48 refs.; with app.

The identification of waves observed by the Helios-search-coil experiment in the solar wind plasma becomes difficult due to Dopplershift. Wave modes as observed in the solar wind are discussed by plasmatheoretical methods. The wave modes and Dopplershift are computed using known plasmaparameters. In order to determine the frequency of a wave mode in a plasma-fixed coordinate system from measured frequency data a special representation is used. The results facilitate the identification of wave modes in the solar wind plasma as measured aboard a spacecraft like Helios. (DE)

27036 EVIDENCE OF MAGNETIC FIELD LINE MERGING IN THE SOLAR WIND. Bavassano, B. (Laboratorio Plasma Spazio, Consiglio Nazionale delle Ricerche, Frascati, Italy); Dobrowolny, M.; Mariani, F. J. Geophys. Res. 81: No. 1, 1-6 (1 Jan 1976).

An analysis is presented of a few of the sector boundary crossings measured by the Pioneer 8 magnetometer. By using a variance matrix technique, evidence is obtained of some amount of magnetic line reconnection through the sector boundaries. The thicknesses of such structures are around $0.1–2\times10^4$ km and are therefore larger than typical ion Larmor radii, in contrast with the magnetic structures characteristic of the geomagnetic tail. A theoretical discussion is given of the possible physical causes of the observed reconnection process. In particular, the possible role of tearing instabilities is analyzed with reference to the results of the observations. (auth)

27037 OCTOBER 1972 SOLAR EVENT: THE THIRD DIMENSION IN SOLAR PARTICLE PROPAGATION. Domingo, V.; Page, D.E.; Wenzel, K. (Space Science Department (ESLAB), European Space Research and Technology Centre, Noordwijk, Netherlands). J. Geophys. Res. 81: No. 1, 43-50 (1 Jan 1976).

From late on October 29 until November 3, 1972, our experiment on the European Space Research Organization satellite Heos 2 recorded the arrival of an enhanced interplanetary particle intensity. A dramatic 'slot' in count rate and other sudden anisotropy and flux changes (measured in and perpendicular to the ecliptic plane) were found to coincide with changes in the θ (north-south) ecliptic direction of the interplanetary magnetic field. However, reorientation of strongly field-aligned particle distributions relative to the detectors was insufficient to explain the intensity changes recorded, and the conclusion had to be drawn that the spacecraft was repeatedly crossing a boundary between one regime and a neighboring one with a different particle population. Since the switching from one regime to the other continued for several days, it would seem reasonable to suggest that the boundary between regimes was roughly parallel to the ecliptic plane. This idea was reinforced by the discovery that each time that the particle regime changed, not only did B_θ change, but the solar wind flow direction changed, the dip angle reversing sign. It would thus appear that when the solar wind blows three-dimensional snakelike tubes in interplanetary space, MeV particles obediently follow the field line bundles within such tubes and experience considerable difficulty in crossing from one tube to a neighboring tube which encloses a different regime. Because of the absence of cross-field particle movement, measurements made at higher solar latitudes, where most solar active regions occur, could reveal a somewhat different picture of the development of solar particle events. (auth)

27038 A SHOCK SURFACE GEOMETRY: THE FEBRUARY 15–16, 1967, EVENT. Lepping, R.P.; Chao, J.K. (Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 81: No. 1, 60-64 (1 Jan 1976).

The flare-associated interplanetary (IP) shock of February 15–16, 1967, observed by Explorer 33 and Pioneer 7 is analyzed to yield an estimation of the ecliptic plane geometry of the shock surface near 1 AU. These spacecraft were separated by 23° in heliocentric longitude, and Pioneer 7 was at a distance of 1.12 AU from the sun. There was an 18.9-hour delay between the two observations. The estimated shock normal, obtained by using a least squares shock parameter fitting

procedure for the Explorer 33 data, is found to be $\theta_{SE}=-53°$ and $\phi_{SE}=198°$, which agrees within the error cone with the estimate of Hirshberg et al. (1970), obtained by using the magnetic coplanarity theorem and the Ames Research Center magnetometer data from Explorer 33. The error cone angle for the shock normal of the Explorer 33 observation was approximately 7°. This severely inclined shock normal is not typical of IP shocks. The shock normal at the Pioneer 7 position is found to be $\theta_n=-14°$ and $\phi_n=161°$, referred to the spacecraft-sun line, by using the magnetic coplanarity theorem and Goddard Space Flight Center magnetic field data. However, the uncertainty is large ($\simeq 25°$ for a 1σ cone angle). Although a data gap occurred at the apparent time of passage of the disturbance at Pioneer 6, which was 85° in heliocentric longitude from Pioneer 7 and 0.83 AU from the sun, the recovered data did not suggest such a passage. A consistent picture of the shock propagation is given to explain the difference in arrival times at Pioneer 6 and 7 and at Explorer 33 and the difference of the shock normals observed by Pioneer 7 and Explorer 33. The average shock speed from the sun to each spacecraft and the local speed at Explorer 33 and their relations to the position of the initating solar flare are obtained and discussed. In the region of space between the earth and Pioneer 7 the shock surface radius of curvature in the ecliptic plane appears to have been 0.4 AU or less. (auth)

27039 MICROSCALE 'ALFVÉN WAVES' IN THE SOLAR WIND AT 1 AU. Burlaga, L.F. (Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771); Turner, J.M. J. Geophys. Res. 81: No. 1, 73-77 (1 Jan 1976).

Analysis of Imp 1 (Explorer 43) interplanetary plasma and magnetic field fluctuations on a scale of 1 hour for the period March 18 to April 7, 1971, reveals that linearly and circularly polarized Alfvén waves were rarely present. Fluctuations having most of the characteristics of large amplitude ($\delta B_n/\bar{B}\simeq 0.4$) 'Alfvén waves' were observed $\simeq 40\%$ of the time and moved away from the sun nearly along B. These were not pure transverse Alfvén waves, however, because they were accompanied by nonzero fluctuations in the magnetic field intensity ($\delta B/\bar{B}\simeq 0.06$). No simple relation between 'Alfvén waves' and streams was found. (auth)

27040 THE ROLE OF COULOMB COLLISIONS IN LIMITING DIFFERENTIAL FLOW AND TEMPERATURE DIFFERENCES IN THE SOLAR WIND. Neugebauer, M. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Geophys. Res. 81: No. 1, 78-82 (1 Jan 1976).

Analysis of data obtained by Ogo 5 confirms the Imp 6 observations of the inverse dependence of the helium to hydrogen temperature ratio T_{He}/T_H on τ_e/τ_c, the ratio of the solar wind expansion time to the Coulomb collision equipartition time. The difference between the absolute values of the averages of T_{He}/T_H as observed by Imp and Ogo is probably due to the difference of the weights given to high- and low-velocity periods by the two experiments. The magnitude of the differential flow vector $\Delta v=|v_{He}-v_H|$ varies inversely with τ_e/τ_s (where τ_s is the Coulomb collision slowing-down time) when τ_e/τ_s is small and approaches zero when τ_e/τ_s is large. The data suggest a model of continuous preferential acceleration and heating of helium (or deceleration and cooling of hydrogen) which is opposed and limited by Coulomb collisions. Since the average dependence of Δv on τ_e/τ_s cannot explain all of the systematic variations of Δv observed in corotating high-velocity streams, extra helium acceleration (or hydrogen deceleration) probably occurs on the leading edge of such streams. (auth)

27041 ON THE NONEXISTENCE OF PLANE-POLARIZED LARGE AMPLITUDE ALFVÉN WAVES. Barnes, A. (Space Science Division, NASA Ames Research Center, Moffett Field, California 94035). J. Geophys. Res. 81: No. 1, 281-282 (1 Jan 1976).

It is shown that purely Alfvénic plane-polarized large amplitude disturbances cannot exist, even in nonplanar fluctuations. (auth)

27042 ABUNDANCES OF SOLAR COSMIC RAY PROTONS AND ALPHA PARTICLES FOR 1969–1972. Stroscio, M.A.; Katz, L.; Yates, G.K. (Air Force Cambridge Research Laboratories, Hanscom Air Force Base, Massachusetts 01731); Sellers, B.; Hanser, F.A. J. Geophys. Res. 81: No. 1, 283-286 (1 Jan 1976).

Hsieh and Simpson have given the abundance ratio of alpha particles and protons for seven solar proton events in 1967. In addition, Lanzerotti and Maclennan have analyzed seven events that occurred during the December 1967 to November 1969 period, which includes the maximum of solar cycle 20. Herein we report a similar analysis based on OV5-6 satellite data for eight events during the November 1969 to November 1972 period after the cycle maximum. The flare-averaged alpha particle to proton ratio reported here varies as $0.032\mathcal{E}^{-0.3}$ in the particle energy range from 2.7 to 8.0 MeV/nucleon. Following the precedent of Lanzerotti and Robbins the alpha particle to proton ratios are determined for (1) equal energy/nucleon, (2) equal rigidity, and (3) equal energy/charge. Finally, a comparison of the yearly average of the total integrated proton and alpha particle fluxes is made for the maximum and descending periods of solar cycle 20. (auth)

27043 A MODEL OF THE SOLAR CYCLE DRIVEN BY THE DYNAMO ACTION OF THE GLOBAL CONVECTION IN THE SOLAR CONVECTION ZONE. Yoshimura, H. (Advanced Study Program, National Center for Atmospheric Research, Boulder, Colorado). Astrophys. J. Suppl. Ser. 29: No. 294, 467-494 (Dec 1975).

The dynamo equation which represents the longitudinally averaged magnetohydrodynamical action of the global convection influenced by the rotation in the solar convection zone is solved numerically to simulate the solar cycle as an initial boundary-value problem. The radial and latitudinal structure of the dynamo action is parametrized in accordance with the structure of the rotation, and of the global convection especially in such a way as to represent the presence of the two cells of the regeneration action in the radial direction in which the action has opposite signs, which is typical of the regeneration action of the global convection. A nonlinear process is included by assuming that part of the magnetic field energy is dissipated when the magnetic field strength exceeds some critical value simulating the formation of active regions and subsequent dissipations. By adjusting the parameters within a reasonable range, oscillatory solutions are obtained to simulate the solar cycle with the period of the right order of magnitude and with the patterns of evolution of the latitudinal distribution of the *toroidal* component of the magnetic field similar to the observed Butterfly Diagram of sunspots. The evolution of the latitudinal distribution of the *radial* component of the magnetic field shows patterns similar to the Butterfly Diagram, but having two branches of different polarity in each hemisphere. The development of the radial structure of the magnetic field associated with the solar cycle is presented to explain the simultaneous presence of active regions with the polarity of the new cycle in the region of magnetic field with the polarity of the old cycle. The importance of the poleward migrating branch of the Butterfly Diagram, barely seen for sunspots but clearly seen for polar prominences and for the observed general magnetic field, is emphasized in relation to the relative importance of the role of the latitudinal and radial shears of the differential rotation. (auth)

27044 GRANULAR-LIKE PATTERN IN SUNSPOT UMBRAE. Bumba, V.; Hejna, L.; Suda, J. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 26: No. 5, 315-316(1975).

A preliminary communication demonstrating the granular-like appearance of the internal parts of all small as well as great umbras of the large complex September 1974 sunspot group. The "bright umbral dots" seem to be the central positions of individual granular-like cells, or even tops of convective elements they may penetrate into the visible layers of the umbra. (auth)

27045 THEORETICAL MODEL OF THE SOLAR CHROMOSPHERE. Marik, M. (Eotvos Lorand Univ., Budapest). Bull. Astron. Inst. Czech.; 26: No. 5, 317-319(1975).

A theoretical model of the solar chromosphere is presented. The model has been calculated under the assumption of the equality of the emission coefficient of the solar matter and the absorption coefficient of weak magnetodynamic shock waves generated in the convective zone. The results show an increase of temperature with height. (auth)

27046 CORONAL INDEX OF SOLAR ACTIVITY. II. Line 5313 A, Years 1972 and 1973. Rybansky, M. (Astronomical Inst. of the Slovak Academy of Sciences, Skalnate Plesa, Czechoslovakia). Bull. Astron. Inst. Czech.; 26: No. 6, 374-377(1975).

The paper is the second part of a more extensive investigation of the coronal index of solar activity. It contains the results covering the years 1972 and 1973. (auth)

27047 CORONAL INDEX OF SOLAR ACTIVITY. I. Line 5313 A, Year 1971. Rybansky, M. (Astronomical Inst. of the Slovak Academy of Sciences, Skalnate Plesa, Czechoslovakia). Bull. Astron. Inst. Czech.; 26: No. 6, 367-374(1975).

The paper describes the procedure for computing the energy emitted by the whole corona in emission line Fe XIV 5303 A. The value of the energy, determined from standard observations of this line at coronal stations, is the proposed index of solar activity in the corona. The results presented cover 1971. In the conclusion the use of the index and of some of the intermediate results of the computation are discussed. (auth)

27048 THEORETICAL ANALYSIS OF VARIOUS STATISTICAL INDICES OF SUNSPOT ACTIVITY. Kopecky, M. (Astronomical Inst. of the Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech.; 26: No. 6, 351-359(1975).

Using the physically primary parameters of sunspot groups (number of sunspot groups originated per unit time $f_0(\tau)$, their frequency distribution according to lifetime $F(T,\tau)$, the pattern of the sunspot group area $S(t,T,\tau)$ and the number of sunspots in the group $\sigma(t,T,\tau)$ as a function of the sunspot group age t), of which it is assumed that they depend on time τ, expressions for the time variation of various indices of sunspot activity (Wolf's relative sunspot number, the number of sunspot groups, the total

area of the sunspots, the average area of the sunspot groups, the number of new sunspot groups on the solar disc) have been derived. It is shown that different forms of the functions $S(t,T,\tau)$ and $\sigma(t,T,\tau)$, which also depend on the phase of the 11-year cycle, are responsible for the different time variations of Wolf's relative number, the total area of the sunspots and the number of observed sunspot groups. If the periodicity of sunspots is to be studied using statistical method with the purpose of discovering regularities in the periodicity of the sunspots which would represent a clue to the physical explanation of the periodicity of sunspots, the analysis indicates that the study of the changes of Wolf's relative sunspot number, of the total area of the sunspots and of the number of existing sunspot groups is quite unsuitable for this research trend and cannot yield new physically true and important regularities of the sunspot periodicity. (auth)

27049 PROTON FLARES OF JULY 1974 GENERATING INTERPLANETARY SHOCK WAVES. Krivsky, L. (Astronomical Inst., Ondrejov, Czechoslovakia); Pinter, S. Bull. Astron. Inst. Czech.; 26: No. 6, 360-364(1975).

The paper contains analysis of the proton flare activity in July 1974 especially in respect to interplanetary shock waves. The time of start of shock waves at the Sun and of their arrival to the Earth are determined; in one case a decelerated wave is traced to the distance of about 5 AU. (auth)

27050 AUTOMATIC SCANNER FOR A HORIZONTAL SOLAR TELESCOPE. Klvana, M. (Astronomical Inst. of the Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech.; 26: No. 6, 364-367(1975).

The scanner is mainly used for the program-controlled motion of the solar image across the entrance slit of the spectrograph during magnetographic observations. The fundamental technical data, the principle, a description of its function with the use of pointing and without it and measurements, characterizing the accuracy of the whole system are discussed. Time is a subsidiary parameter in the system mentioned. The position of the observed region is only determined by the number of impulses and, therefore, if the rotation of the Sun can be neglected, it is independent of time. (auth)

27051 CENTER-TO-LIMB CHANGE OF PROFILES OF WEAK FRAUNHOFER LINES. V. The Radial and Tangential Components of the Photospheric Motion Field. Gurtovenko, E. A. (Main Astronomic Observatory, Kiev). Astrometriya Astrofiz.; No. 27, 67-74(1975). (In Russian)

The center-to-limb analysis of 73 weak Fraunhofer lines was carried out. The lines were supposed to have Voight profiles. Their damping parameters as well as the thermal velocities of the absorbing particles were calculated for the specific optical depths and were taken into account. As a result the tangential (V^{tg}) and radial (V^{rad}) components of the photospheric motion field were obtained. The values of V^{rad} and V^{tg} increase smoothly with the depth. In the region of the larger optical depths both components decrease smoothly. (10 refs., 3 figs., 2 tables) (auth)

27052 RELATIVE INTENSITIES OF HELIUM AND HYDROGEN LINES IN QUIESCENT PROMINENCES. II. Structure-Filamentary Model. Morozhenko, N. N. (Main Astronomic Observatory, Kiev). Astrometriya Astrofiz.; No. 27, 75-85(1975). (In Russian)

A diffusion penetration of ionized helium radiation in filamentary structured prominences is considered. The system of equations was solved consisting of transfer of radiation with $\lambda \geq 504$ Å, ionized equation of helium atom and stationarity of its triplet system. When a consistency was reached of calculations and observations the parameters of thin filamentary structure of prominences were found. (21 refs., 4 figs., 1 table) (auth)

27053 PHYSICAL CONDITIONS IN THE FLARE-LIKE PROMINENCE. Rudnikova, E. G. (Astronomical Observatory, Kiev). Astrometriya Astrofiz.; No. 27, 86-93(1975). (In Russian)

The parameters $T_e = 9700$ K, $n_c = 1.2 \times 10^{11}$ cm^{-3}, $\tau(H\alpha) = 213$, $\tau(H,Ca^+) = 31$, $l = 6.6 \times 10^5$ cm for the first two hydrogen levels and 4S, 4P, Ca^+ terms are determined for a flare-like prominence by means of a self-consistent solution of steady-state equations. (26 refs., 1 fig., 6 tables) (auth)

27054 FORECASTING THE DISPLACEMENT OF THE CENTER OF GRAVITY OF THE S COMPONENT OF THE SOLAR RADIO EMISSION. Krylov, V. A.; Kurbanov, A. Dokl. Akad. Nauk Tadzh. SSR; 18: No. 8, 10-14(1975). (In Russian).

The problem of the short-range forecasting of the running values of the displacement of the center of gravity of the S component of the solar radio emission was set up and solved on the basis of the proposed statistical model of this process. (JSR)

27055 IS THE SUN SPHERICAL. Krasinski, A. (Zaklad Astronomii, Warsaw). Postepy Astron.; 23: No. 3, 159-175(1975). (In Polish).

The article is a review of Dicke's work on the hypothetical quadrupole moment of the Sun. There are presented: the difficulties of the 19th century astronomy connected with the perihelion motion of Mercury, which led the astronomers to the first suspicion that the Sun might have a quadrupole moment. The historical pedigree and the field equations of the Brans-Dicke theory, together with the meaning of the solar quadrupole moment for this theory. A theoretical model of structure of the Sun with rapidly rotating core. The experiment of Dicke and Goldenberg in which the Sun's quadrupole moment was supposed to be measured. The experiment of Hill and coworkers, suggesting the absence of any meaningful quadrupole moment in the Sun. (auth)

27056 ANALYSIS OF THE SOLAR SPECTRUM: RESULTS FOR THE RANGE λ 6105.0–λ6116.5. Dingens, P.; Steyaert, H.; Baeck, N. (Univ., Ghent). Bull. Cl. Sci., Acad. R. Belg.; 41: No. 5, 810-814(1975).

Applying a newly proposed method for decomposing the solar spectrum into Gaussian components, the obtained results are given for the interval λ 6105.0 to λ 6116.5. There are 61 components, with their central wavelength, equivalent width, (reciprocal) standard deviation, and tentative identification listed. (auth)

27057 RADIOMETRIC CHRONOLOGY OF THE EARLY SOLAR SYSTEM. Wetherill, G. W. (Carnegie Institution of Washington, DC). Annu. Rev. Nucl. Sci.; 25: 283-328(1975).

Radiometric dating methods are used to study significant events in the evolution of the solar system. Emphasis is placed on the formational era, beginning approximately 4.7 billion years ago and lasting 250 million years. The formation of planetesimals which took place at this time is discussed. 141 references. (BJG)

27058 SCINTILLATION STUDIES OF DENSITY MICROSTRUCTURE IN THE SOLAR WIND PLASMA. Harmon, J. K. San Diego, CA; Univ. of California (1975). 105p. University Microfilms Order No. 75-29,440.

Thesis (Ph. D.).

Interplanetary scintillation observations made with the 74 MHz system at UCSD are used to infer the spatial power spectrum of microscale density fluctuations, and the distribution of microstructure in the solar wind. A technique for estimating the density power spectrum directly from the IPS intensity spectrum is described. The estimation algorithm is applied to a large body of data obtained during 1972–73. Large fluctuations in the shape of the estimated density spectrum are interpreted as bias associated with the passage of high speed streams through the line of sight, rather than changes in the intrinsic shape of the spectrum. When this bias is accounted for, it is found that the density spectrum has a power law slope alpha approximately equal to 2.8 in the wave-number range .002 less than q less than .01 km^{-1}, and steepens to alpha approximately equal to 3.2 for q greater than .01 km^{-1}. In light of spacecraft measurements at other wavenumbers, this is consistent with a moderate flattening of the density spectrum in the microscale regime. (Diss. Abstr. Int., B)

27059 2.2 MeV AND 0.51 MeV GAMMA-RAY LINE EMISSIONS FROM SOLAR FLARES. Wang, H. T. College Park, MD; Univ. of Maryland (1975). 106p. University Microfilms Order No. 75-28,942.

Thesis (Ph. D.).

The formation of the 2.2 MeV and 0.51 MeV gamma-ray lines from solar flares is calculated and the results are compared with observations of the August 4 and 7, 1972 flares. For the 2.2 MeV line, a Monte-Carlo method is used for neutron and 2.2 MeV photon propagation in solar atmosphere, taking into account escape, decay and loss on ^{3}He for neutrons, and Compton scattering for 2.2 MeV photons. For the 0.51 MeV line, the full energy spectrum of positrons from pi^+ decay, the slowing-down process of positrons, the mean life of beta$^+$ emitting nuclei and the annihilation and positronium formations of the positrons in the ambient medium were taken into account. The width of the 2.2 MeV line is very narrow and is not broadened by the Doppler and Compton effects. For an isotropic release of neutrons, the 2.2 MeV photon yield per neutron is between about 0.05 to 0.02 provided that the flare is not too close to the solar limb and the photospheric ^{3}He/H ratio is less than 5×10^{-5}. The time lags between the nuclear reactions and the formation of the 2.2 MeV and 0.51 MeV lines are caused respectively, by capture of the neutrons, and by deceleration of the positrons and decay of the radioactive nuclei. The lag can explain the delayed gamma-ray emission on August 7. Positrons of energies greater than about 10 MeV could be detected in interplanetary space following large solar flares. (Diss. Abstr. Int., B)

27060 OBSERVATIONAL INVESTIGATION OF THE SOLAR OBLATENESS. Stebbins, R. T. Boulder, CO; Univ. of Col-

orado (1975). 170p. University Microfilms Order No. 76-3955.

Thesis (Ph. D.)

The solar oblateness provides important information for solar physics and experimental relativity. After the solar neutrino flux, the sun's shape is the most revealing probe of the solar interior. Rapidly rotating interiors suggested to explain the solar neutrino paradox produce sizeable oblatenesses. Certain types of surface phenomena can also be investigated with precision diameter measurements. The relativistic advance of Mercury's perihelion has long been the principal experimental support for Einstein's theory of general relativity. Recent measurements of the solar oblateness have suggested that the relativistic advance is smaller than originally thought due to a contribution from a solar mass quadrupole moment. This interpretation of the perihelion advance would shift the experimental support to the scalar-tensor theory of gravitation. A debate over the interpretation of the oblateness measurements has resulted. In light of these circumstances, solar oblateness observations have been attempted. Improved experimental techniques have been devised, including a daytime astrometric telescope and an explicit definition of the sun's edge. Observations reveal a time varying excess equatorial brightness, that is, a variation in the limb darkening function between equator and pole, which would preclude accurate interpretation of previous solar oblateness measurements. This vindicates the alternate interpretations of other solar oblateness measurements. From these results, it can be concluded that the Mercury perihelion evidence firmly supports Einstein's General Theory of Relativity, the solar interiors cannot be rotating fast enough to account for the low solar neutrino flux, and a time varying excess equatorial brightness exists. (Diss. Abstr. Int., B)

Galaxies

Refer also to abstracts 26978, 27012, 27030, 27032, 27033, and 27900.

27061 (AD/A-005570) OH ZEEMAN OBSERVATIONS OF INTERSTELLAR DUST CLOUDS. Crutcher, R. M.; Evans, N. J. II.; Troland, T.; Heiles, C. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1975. Contract N00014-67-A-0094-0019. 9p. NTIS $3.25.

Zeeman splitting of OH emission lines in two dust clouds was measured. The upper limits on the Zeeman splitting indicate that the large-scale magnetic fields are less than 50 microgauss, a value significantly less than that expected if the magnetic field is frozen in during collapse. (GRA)

27062 (MPI-PAE/Astro-70) LECTURE NOTES ON MOLECULAR PROCESSES IN INTERSTELLAR CLOUDS. Dalgarno, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Sep 1975. vp. INIS.

With figs., tabs. and refs. Available from ZAED.

The main topics of these lecture notes are: molecular formation processes, molecular photodestruction processes, recombination processes, gas phase formation schemes in interstellar clouds, rotational population of H_2 in interstellar clouds, energy loss processes, heating mechanisms. (DE)

27063 COOL STELLAR POPULATIONS IN *E/S0* GALAXIES AND A POSSIBLE OUTBURST IN M87. O'Connell, R.W. (University of Virginia). Astrophys. J. Lett. 203: No. 1, L1-L4 (1 Jan 1976).

We discuss a scanner survey of the 0.7–1.1 μ energy distributions of the nuclei of *E/S0* galaxies ranging over a factor of 100 in intrinsic luminosity. There is a mild (color, absolute magnitude) -correlation. The strength of the λ8542 Ca II + TiO absorption feature appears to reach a maximum near $M_V \simeq -20.5$, which may be due to a maximum in the density of low-mass stars in short-lived phases near the tip of the asymptotic giant branch. The color of the nucleus of M87 is anomalously blue for its luminosity, possibly indicating that a nonthermal or supernova outburst has recently occurred. (auth)

27064 POLARIZATION STUDIES OF THE INFRARED SOURCE CRL 2688 AT VISIBLE WAVELENGTHS. Michalsky, J.J. (Batelle Observatory, Battelle-Northwest Laboratories, Richland, Washington); Stokes, R.A.; Ekstrom, P.A. Astrophys. J. Lett. 203: No. 1, L43-L45 (1 Jan 1976).

A study of the polarization of the entire nebulosity surrounding the unusual infrared source CRL 2688 is presented. Wavelength coverage from 3800 to 7800 Å reveals that the linear polarization increases monotonically with wavelength. Circular polarization was discovered and found to be a constant over the same wavelength range. The implications of these findings in terms of the scattering particles producing the polarization are discussed. (auth)

27065 RATIO OF EXTINCTION TO REDDENING FOR INTERSTELLAR MATTER USING GALAXIES. I. A Limit on the Neutral Extinction from Photometry of the 3C 129 Group. Sandage, A. Publ. Astron. Soc. Pac.; 87: No. 520, 853-857 (Dec 1975).

The ratio of total extinction to reddening of interstellar matter has been determined by a new method applied to galaxies in the highly obscured 3C 129 and 3C 129.1 group (l equals 160^0, b equals 0^0). The difference between the observed magnitude of the first-ranked group member and the magnitude calculated from the redshift-apparent magnitude (Hubble) diagram (at the known redshift of the group) is the total extinction A/sub v/ to within the sigma (M/sub v/) that applies to the first-ranked cluster member. Comparison of the observed color with the known intrinsic color of giant E galaxies gives E(B-V), and therefore R. Photometry of the 3C 129 group gives R identical with A/sub v//E(B-V) equals 3.72 +- 0.32 (sigma). Correction for the finite bandwidth of the BV system gives R (O star base) equals 3.35 +- 0.29 (sigma). Comparison with R determined from the color-difference method gives a limit for the fraction of neutral-to-selective extinction of f equals A/sub v/ (neutral)/A/sub v/ (selective) equals 0.10 +- 0.15 (sigma) which is a null result (f equals 0) to within the statistics. Hence, no neutral extinction has been detected at the 1 sigma level of the experiment. Use of the method on many additional groups of galaxies is expected to substantially reduce the error of this limit. (auth)

27066 VELOCITY GRADIENT OF THE GAS ALONG THE APPARENT MINOR AXIS OF THE GALAXY NGC 2685. Ulrich, M. H. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 87: No. 520, 965-967 (Dec 1975).

Spectrograms were taken in the direction of the apparent minor axis of the peculiar galaxy NGC 2685. Measurements along the [O II] lambda 3727 emission feature within 10" from the center show that the line-of-sight velocity of the ionized gas increases by approximately equal to 250 km s^{-1} from the NW side to SE side of the inner region of the galaxy. (auth)

27067 SPECTRAL ENERGY DISTRIBUTION OF NGC 1275. Shields, G. A. (Univ. of Texas, Austin); Oke, J. B. Publ. Astron. Soc. Pac.; 87: No. 520, 879-883 (Dec 1975).

An analysis of absolute spectral energy distributions for NGC 1275 (Per A) covering the wavelength interval lambda lambda 3300-10,800 is presented. The data are consistent with the heavy reddening discovered by Wampler. The H alpha intensity varied by less than 10 percent between the times of Wampler's earlier measurements and the two occasions of our observations. The line-emitting region has a characteristic density approximately $10^{4.5}$ cm^{-3}, a mass approximately $10^{5.5}$ solar mass, and a volume filling factor approximately 10^{-6}. The gas may be ionized by shock waves or by nonthermal or stellar radiation. It is again suggested, in the vein of Minkowski's original proposal, that the high-velocity, emission-line knots described by Minkowski are H II regions in a Perseus cluster galaxy or intergalactic gas cloud seen in projection against NGC 1275. (auth)

27068 INTERMEDIATE- AND WIDE-BAND PHOTOMETRY OF NGC 6025. Kilambi, G. C. (Univ. of Pennsylvania, Philadelphia). Publ. Astron. Soc. Pac.; 87: No. 520, 975-981 (Dec 1975).

The uvby photoelectric photometry and UBV photographic photometry of NGC 6025 have yielded a distance modulus of 9.7 +- 0.1 and an age of 90 million years. No major deviation from a normal interstellar reddening law has been noted. A gap in the (B-V) distribution of stars has been detected and the luminosity function has been derived. (auth)

27069 OPTICAL EMISSION-LINE SPECTRUM OF 3C 120. Phillips, M. M.; Osterbrock, D. E. (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac.; 87: No. 520, 949-959 (Dec 1975).

Spectrophotometric measurements are reported of the nuclear region of 3C 120. The relative intensities of the individual emission lines and the continuous spectrum were measured in the wavelength region lambda lambda 3346-7065 (in the rest system of 3C 120). The Balmer decrement is quite steep and may be caused by interstellar extinction of an amount E/sub B-V/ equals 0.50. However, it is more likely that the large decrement is the result of collisional or self-absorption effects. The observations by Wampler and Shields, Oke, and Sargent of strong He I and He II emission lines are confirmed. The relative strengths of the He I lines are inconsistent with pure recombination theory and suggest that collisional or radiative transfer processes are important. The [S II] ratio F(lambda 6717)/F(lambda 6731) equals 0.91 corresponds to a mean electron density of N/sub e/ (10^4/T)/sup ½/ equals 1.7×10^3 cm^{-3} in the region of [S II] emission. The [O III] ratio [F(lambda 5007) + F(4959)]/F(lambda 4363) equals 23.1 (uncorrected for reddening) implies an electron temperature

of 32,500°K in the low-density limit N/sub e/ yields 0, and approximately 23,000°K for a density of 10^5 cm^{-3}. Broad emission features of Fe II are present in the spectrum. In particular, a weak emission line at lambda 6369 may be identified with an Fe II transition of multiplet (40). The profiles of the H I, He I, and He II lines are fairly symmetrical, with the full width at half maximum of the H I and He I lines approximately 2000 km s^{-1}, while He II lambda 4686 appears to have somewhat wider wings. The narrower forbidden lines have widths of roughly 300 km s^{-1}. A comparison of the relative forbidden line strengths to those of Cygnus A suggests the presence of a rather complicated distribution of density with degree of ionization in 3C 120. (auth)

27070 GAS LOSS IN GROUPS OF GALAXIES. Larson, R. B.; Dinerstein, H. L. Publ. Astron. Soc. Pac.; 87: No. 520, 911-915 (Dec 1975).

Estimates are made of the total amount of mass and the total amount of heavy elements expected to be lost during the early evolution of the galaxies in a typical group or cluster. The estimated amount of gas lost is roughly one quarter of the mass present in galaxies, and the metal abundance of the lost gas is essentially solar. Several possibilities concerning the fate of the gas lost from galaxies are discussed. (auth)

27071 CALAN 129-1: A SOUTHERN DOUBLE CLUSTER OF GALAXIES. Quintana, H.; Melnick, J. (Universidad de Chile, Santiago). Publ. Astron. Soc. Pac.; 87: No. 520, 863-867(Dec 1975).

Observations of a peculiar southern cluster with Abell richness class O and a redshift of 0.015 are presented. A population and morphology analysis leads to the interpretation that this is a system of two clusters. Some evidence suggesting an interaction due to intracluster gas is also briefly discussed. (auth)

27072 A SEARCH FOR WATER VAPOR EMISSION FROM EXTRAGALACTIC NEBULAE. Andrew, B. H.; Bell, M. B.; Broten, N. W.; MacLeod, J. M. (National Research Council of Canada, Ottawa, Ontario. Herzberg Inst. of Astrophysics). Astron. Astrophys.; 39: No. 2, 421-428(Mar 1975).

2 figs.; 7 tabs.; 35 refs.

A search was conducted for water vapor emission at 132 independent positions in seven external galaxies. No emission was detected, with the possible exception of a line seen one night out of four at the position of the nucleus of M 82. (DE)

27073 EXISTENCE OF THIRD-ORDER CLUSTERS OF GALAXIES AMONG ED CLUSTERS. Kalinkov, M.; Stavrev, K.; Dermendjiev, V. (Dept. of Astronomy, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 11, 1443-1445(1975).

The results of the application of the B correlation method for the two-dimensional case and its possibilities for Zwicky ED clusters are given. The determined correlation functions for the field, representing the distribution of ED galaxy clusters are given and refer to three different essential breakups. (JFP)

27074 CARBON MONOXIDE EMISSION FROM INTERSTELLAR DUST CLOUDS. Milman, A. S. College Park, MD; Univ. of Maryland (1975). 100p. University Microfilms Order No. 75-29,123.

Thesis (Ph. D.).

Observations of the J equals 1-0 rotational lines of $^{12}C^{16}O$ and $^{13}C^{16}O$ in two dust clouds, the North America nebula dust cloud and L1630 are reported. The observations have higher velocity resolution (delta v equals 0.25 km s^{-1}) than had been available previously. In an earlier paper, unusually bright CO emission associated with the reflection nebulae NGC 2023 and NGC 2068 in L1630 is noted. Bright CO emission is looked for from the directions of individual H alpha-emission stars in L1630 and the North America dust cloud, but the CO emission at these places is not enhanced above that of the surrounding material. It is concluded that these stars are too cool to heat the gas appreciably. The shapes of the CO profiles are determined by the large-scale motions of the gas in dust clouds. The possibility that magnetic fields in dust clouds prevent rapid dissipation of turbulent motions in these clouds is discussed. The shapes of the CO profiles observed near NGC 2023 show that the gas motions there are turbulent, rather than radial. From the observations of the North America dust cloud, it is shown that not more than about 10 percent of the carbon present in the gas is in the form of CO. A model of CO excitation in a homogeneous, spherical cloud with a constant source function is described, and the effects of radiative trapping in the model are studied. Some numerical results are presented, that show how the CO brightness temperature is determined by the CO column density and the density of the gas. The problem of making realistic models of dust clouds is briefly discussed, and some suggestions are made about possible future observations that would be useful to determine whether the motions of the gas are predominantly turbulent or radial (expansion or collapse). (Diss. Abstr. Int., B)

27075 CORRELATION OF RADIO EMISSION AND OPTICAL MORPHOLOGY IN PECULIAR GALAXIES. Sulentic, J. W. Albany; State Univ. of New York (1975). 130p. University Microfilms Order No. 75-28,898.

Thesis (Ph. D.).

A radio survey was made of the majority of the systems in the Arp Atlas of Peculiar Galaxies. This study, conducted at 1400, 2700, and 5000 MHz, is supplemented by extensive data available in the literature. The principal aim in this study is to intercompare radio properties with optical morphology although special emphasis is given the comparison of the multiple galaxies in the sample with both normal and peculiar single galaxies. (Diss. Abstr. Int., B)

27076 UNIFIED MODEL OF INTERSTELLAR GRAINS. Hong, S. S. Albany; State Univ. of New York (1975). 134p. University Microfilms Order No. 76-1899.

Thesis (Ph. D.).

On the basis of a very simple analytical approximation for the forward scattering amplitude function, a unified interpretation to the observed inter-relationships between the wavelength dependences of interstellar extinction and linear and circular polarization is given. Thus, these three key observations are timed intimately to each other by the classical theory of light scattering. An interstellar grain model is proposed to explain simultaneously such basic observations. The model is composed of two populations: core-mantle particles in 0.1 micron size range, and very small uncoated particles generally less than 0.01 micron in size. The composition of the core-mantle particle is inferred from the observations of infrared absorption bands; the cores consist of silicate, and the mantles are a solid mixture of oxygen, carbon and nitrogen with hydrogen. Theoretical extinction, and linear and circular polarization curves based on the core-mantle bimodal grain model have been directly compared with the corresponding observations. It is shown that interstellar dust contains most of the available magnesium, iron and silicon atoms in interstellar space. The temperature history of the very small grains in unshielded interstellar space is examined. The photons from the interstellar radiation field cause extreme temperature fluctuations to the uncoated grains due to their small sizes. In order to estimate the effects of such random temperature fluctuations upon the temperature-dependent processes, the temperature distribution function of the small grains in the interstellar radiation field is derived and mean evaporation rates of molecules from the small grain surface are estimated. Physical justification of the bimodal configuration is given by showing that the temperature fluctuation will prevent the very small grains from forming mantles onto their surfaces, if the desorption energies of the accreted molecules are less than about 0.3 electron-volts. (Diss. Abstr. Int., B)

27077 INFRARED EMISSION FROM GALACTIC HII REGIONS. Zeilik, M. II. Cambridge, MA; Harvard Univ. (1975). 120p. University Microfilms Order No. 76-4473.

Thesis (Ph. D.).

Near-infrared observations are presented of selected galactic HII regions (especially G45.5 + 0.1, G45.1 + 0.1, S88, and W3A) to infer the physical conditions of the dust responsible for the 2 to 25 micron emission. Two-component dust models are developed to match the observed characteristics of the infrared emission from HII regions. The dust, assumed to be bare and well-mixed with the gas in the ionized volume, consists of large (0.1 micron) "silicate" grains and small (0.2 micron) graphite grains. The "silicates" have their cosmic maximum abundance with respect to hydrogen, but the graphite grains are depleted by factors of 25 to 100 in mass. The Lyman-alpha radiation field predominately heats the "silicate" grains, which produce almost all the emission at 20 microns and most of it from 8 to 13 microns. The stellar radiation field predominately heats the graphite grains, which generate most of the emission at 3.5 and 5 microns. Roughly half of the observed 2 to 25 micron luminosity (when corrected for extinction) arises from Lyman-alpha photons and the other half from the Lyman and Balmer continua. The grains are too hot to provide significant emission in the far-infrared; this probably arises from a dust shell around the HII region. This two-component model predicts that HII regions should have smaller sizes at 3.5 and 5 microns than at 10 and 20 microns. The emissivities of fine-structure infrared lines for the regions are calculated. In the one instance where observations of such lines have been published (G29.9 - 0.0), predicted emissivities fall below those observed, especially for the 12.86-micron line of NeII. The discrepancy probably arises from an incorrect modeling of the region's ionization structure, but it might also reflect variations in elemental abundances or deficiencies in model stellar atmospheres for hot stars. (Diss. Abstr. Int., B)

Cosmology

Refer also to abstracts 25853, 26390, 27012, 27900, and 27928.

27078 COSMOLOGICAL SINGULARITIES IN A THEORY OF GRAVITATION WITH SECOND ORDER PERTURBATIONS. Giesswein, M.; Streeruwitz, E. (Univ., Vienna). Acta Phys. Austriaca; 41: No. 1, 41-64(1975). (In German)

General relativity is modified by adding quadratic terms in the Riemann tensor, i.e. R^2, $R^{\mu\nu}R_{\mu\nu}$, $R^{\mu\nu\rho\sigma}R_{\mu\nu\rho\sigma}$, to the Lagrangian. These terms are likely to be due to effects of quantization of the matter fields (source fields) in general relativity. The resulting field equations are specialized to homogeneous isotropic cosmologies (Robertson-Walker metric, k = 0, ±1). These field equations are integrated numerically for a universe containing an isotropic radiation field (radiation dominated area). By combining numerical and analytical methods it can be shown that the modification of the field equations prevents the occurrence of singularities in some cases. It turns out, however, that the asymptotic behavior of these collapse free solutions is drastically modified and does not correspond to a Friedmann universe in the limit of large time. Quantum modifications of general relativity of the form considered here are therefore unable to prevent the occurrence of singularities of Friedmann type universes. (auth)

27079 HAMILTONIAN TREATMENT OF A QUANTUM SCALAR FIELD IN A BIANCHI I UNIVERSE. Pessa, E. (Univ., Rome). Lett. Nuovo Cim.; 15: No. 9, 295-299(28 Feb 1976).

It is shown that with the aid of an Hamiltonian formalism, which is developed, it is possible to treat the problem of a quantum scalar field in a Bianchi I universe of a given metric, taking into account the reaction of the scalar field on the metric itself. Some preliminary calculations show that the process of particle creation, treated within the context of this formalism can account for a large part of the matter content of the universe; it is hoped that subsequent calculations can aid in the problem of the dissipation of the initial anisotropy of the universe. (JFP)

27080 CURVATURE COLLINEATION FOR PLANE SYMMETRIC COSMOLOGICAL MODEL. Singh, K. P.; Shri Ram. (Banarus Hindu Univ., India). Indian J. Phys.; 5: No. 3, 241-245(Mar 1974).

It is shown that the plane symmetric cosmological model admits proper curvature collineation (CC) only when it is filled with photonfluid. The CC vector was determined. (auth)

27081 MAXIMUM ENTROPY AND ROTATING UNIVERSES. Petit, J. P.; Monnet, G. (Observatoire de Marseille, 13 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 23, 733-735 (16 Jun 1975). (In French)

The general non-steady Maxwellian solution of the Vlasov and Poisson equations is derived. One finds that the density of particles and the temperature are functions of the time only. The field of macroscopic velocity is found to be a combination of Hubble's field and of a solid body rotation, in which the angular velocity varies like the temperature. The characteristic length R of this Newtonian system obeys a pseudo Friedman equation, previously obtained by Heckmann and Suecking. The features of the Newtonian cosmology are established through an approach that takes account of the corpuscular nature of matter. (FR)

27082 ENTROPY IN AN OSCILLATING UNIVERSE. Landsberg, P. T. (Southampton Univ., Eng.); Park, D. Proc. R. Soc. (London), Ser. A; 346: No. 1647, 485-495(25 Nov 1975).

Irreversible processes in a model universe containing gas and radiation are studied. By making simplified but plausible hypotheses regarding the exchange of energy between the two components, the effects of these processes are traced, as manifested in the dynamical behavior of the model and in the evolution of a suitably defined entropy. The dynamical behavior is found to change systematically from cycle to cycle, coming to resemble more and more closely that of a system that is just barely bound (i.e. just contracting). The entropy increases continuously, and so provides an arrow of time even in the contracting phase. These conclusions are illustrated with numerical computations. (auth)

27083 GRAVITATIONAL RADIATION EXPERIMENTS AT THE UNIVERSITY OF READING AND THE RUTHERFORD LABORATORY. Allen, W. D. (Rutherford Lab., Chilton, Eng.); Christodoulides, C. J. Phys., A (London); 8: No. 11, 1726-1733(Nov 1975).

The results are reported of a search for short pulses of gravitational radiation, using two split-bar detectors 30 km apart. The detectors have masses of 625 kg each and are capable of millisecond resolution over a broad band around 1200 Hz. Pulses imparting energy of ½ to 1 kT to each bar, and coincident within ±1 ms, were indistinguishable in trace characteristics from pulses due to thermal noise; and the number in the bin registering coincidences within ±2 ms (i.e., 308 in total), was indistinguishable from the numbers in bins of the same timewidth but registering coincidences with time differences of up to ±10 ms between the two detectors. (auth)

27084 WILL THE UNIVERSE EXPAND FOREVER. Gott, J. R. III; Gunn, J. E.; Schramm, D. N.; Tinsley, B. M. Sci. Am.; 234: No. 3, 62-65, 68-72B, 77, 79(Mar 1976).

Plausible cosmological models are examined with respect to measurements of deceleration, the age of the universe, the average density of matter, and the abundance of deuterium. These factors together indicate that the expansion of the universe cannot be halted or reversed, that the universe is open. (BJG)

Planetary Phenomena

Refer also to abstract 27006.

27085 (AD-A-008572) ENERGETIC ELECTRONS IN THE JOVIAN MAGNETOSPHERE. Progress Report. Baker, D. N.; Van Allen, J. A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Mar 1975. Contract N00014-68-A-0196-0009. 71p. NTIS $4.25.

Detailed analysis of the University of Iowa Pioneer 10 data using several design features of the instrument to accomplish particle species identification shows that the observed counting rates within the magnetosphere of Jupiter were caused primarily by electrons, $E_e > 0.06$ MeV. This identification holds for the magnetodisc region ($r \cong$ or $< R_J$, Jovian radii) as well as for the central magnetosphere ($r \cong$ or $< R_J$), as reported previously by Van Allen et al. (1974). Absolute omnidirectional intensities of electrons in the magnetodisc are presented for five integral energy ranges: $E_e > 0.06$, >0.55, >5, >21, and >31 MeV. (GRA)

27086 JOVIAN ELECTRON BURSTS: CORRELATION WITH THE INTERPLANETARY FIELD DIRECTION AND HYDROMAGNETIC WAVES. Smith, E.J.; Tsurutani, B.T. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103); Chenette, D.L.; Conlon, T.F.; Simpson, J.A. J. Geophys. Res. 81: No. 1, 65-72 (1 Jan 1976).

The bursts of relativistic electrons detected on Pioneer 10 upstream from Jupiter and within $400r_J$ of the planet have been found to be correlated with the interplanetary magnetic field. In the three examples upon which this study is based, during the month prior to the Pioneer 10 encounter, electrons with energies between 3 and 6 MeV escaping from Jupiter's magnetosphere were observed only when the interplanetary magnetic field was along the Jupiter-spacecraft line. In addition, large-amplitude interplanetary waves with characteristic periods of 10 min were observed and found to be well correlated with intervals during which the field was along the Jupiter-spacecraft line. Abrupt changes in the field away from the preferred direction caused equally abrupt terminations of the waves with an accompanying reduction in the electron flux. These results are consistent with propagation of the electrons from Jupiter to Pioneer along, rather than across, the magnetic field lines. The direction of the interplanetary magnetic field is apparently not affected by the electron bursts or by other particles from Jupiter. A histogram of 1-min averages of the interplanetary magnetic field longitude during the period of the study clearly shows the average Parker spiral direction with no enhancement in the Jupiter-spacecraft direction. Two alternative possibilities are considered for the origin of the waves. If they were generated near Jupiter, they would have to propagate to the spacecraft in the whistler mode. The expected attenuation of these waves over distances of several hundred r_J and their long travel times make this explanation unattractive. Alternatively, hydromagnetic wave generation by Jovian charged particles, presumably the relativistic electrons themselves, as they travel upstream, appears to be an attractive explanation. At the observed frequency, hydromagnetic waves are Doppler-shifted to the gyrofrequency of the relativistic electrons. A plasma instability that appears capable of explaining the observations is a cyclotron overstability originally discovered in thermonuclear research that occurs when the velocity of runaway electrons exceeds the velocity of hydromagnetic waves. (auth)

27087 ENDURING METEOR TRAINS AND CHEMILUMINESCENCE. Baggaley, W. J. (Univ. of Canterbury, New Zealand). Bull. Astron. Inst. Czech.; 26: No. 5, 273-275(1975).

The nitric oxide afterglow and nitrogen dioxide air-glow chemiluminescent processes are examined quantitatively and shown to be quite inadequate as a source of enduring meteor train luminosity. (auth)

27088 MOTION OF SHOCKS THROUGH INTERPLANETARY STREAMS. Burlaga, L. F.; Scudder, J. D. (Lab. for Extra-

terrestrial Physics, Greenbelt, MD). J. Geophys. Res.; 80: No. 28, 4004-4010 (1 Oct 1975).

A model for the motion of flare-generated shocks through interplanetary streams is presented, illustrating the effects of a stream-shock interaction on the shock strength and geometry. It is a gas dynamic calculation based on Whitham's method and on an empirical approximation for the relevant characteristics of streams. The results show that the Mach number of a shock can decrease appreciably to near unity in the interaction region ahead of streams and that the interaction of a spherically symmetric shock with a spiral-shaped corotating stream can cause significant distortions of the initial shock front geometry. The geometry of the February 15–16, 1967, shock discussed by Lepping and Chao (1972) is qualitatively explained by this model. (auth)

27089 REINTERPRETATION OF THE REPORTED ENERGETIC PARTICLE FLUXES IN THE VICINITY OF MERCURY. Armstrong, T. P. (Univ. of Kansas, Lawrence); Krimigis, S. M.; Lanzerotti, L. J. J. Geophys. Res.; 80: No. 28, 4015-4017 (1 Oct 1975).

During the Mercury flyby of Mariner 10, observations of large fluxes of energetic electrons (E less than 0.3 MeV) and protons (0.53 greater than E greater than 1.9 MeV) have been reported by Simpson et al. (1974a). The reported simultaneous enhancements of protons and electrons in the magnetic field of Mercury have raised some perplexing planetology questions. It is shown here that the response of the proton detector in the Mariner 10 experiment is most plausibly attributable to the pileup of low-energy electrons rather than the presence of protons in the vicinity of Mercury. Further, the reported lower-limit electron differential spectrum exponent of gamma less than or equal to 9 and the 300-keV electron fluxes are probably in quantitative error, especially where the count rates are highest. It is concluded that no "new" acceleration mechanism has been identified at Mercury. (auth)

27090 FORMATION OF GIANT PLANETS. Perri, F. New York, NY; Yeshiva Univ. (1975). 72p. University Microfilms Order No. 76-4550.

Thesis (Ph. D.).

When a planetary core composed of condensed matter is accumulated in the primitive solar nebula, the gas of the nebula becomes gravitationally concentrated as an envelope surrounding the planetary core. Models of such gaseous envelopes have been constructed subject to the assumption that the gas everywhere is on the same adiabat as that in the surrounding nebula. The gaseous envelope extends from the surface of the core to the distance at which the gravitational attraction of core plus envelope becomes equal to the gradient of the gravitational potential in the solar nebula; at this point the pressure and temperature of the gas in the envelope are required to attain the background values characteristic of the solar nebula. In general, as the mass of the condensed core increases, increasing amounts of gas became concentrated in the envelope, and these envelopes are stable against hydrodynamic instabilities. However, the core mass then goes through a maximum and starts to decrease. In most of the models tested the envelopes were hydrodynamically unstable beyond the peak in the core mass. An unstable situation was always created if it was insisted that the core mass contain a larger amount of matter than given by these solutions. For an initial adiabat characterized by a temperature of 450°K and a pressure of 5×10^{-6} atmospheres, the maximum core mass at which instability occurs is approximately 115 earth masses. It is concluded that the giant planets obtained their large amounts of hydrogen and helium by a hydrodynamic collapse process in the solar nebula only after the nebula had been subjected to a considerable period of cooling. (Diss. Abstr. Int., B)

27091 PROTON STIMULATED CHEMISTRY IN THE OUTER SOLAR SYSTEM. Scattergood, T. W. Stony Brook, NY; State Univ. of New York (1975). 202p. University Microfilms Order No. 76-1145.

Thesis (Ph. D.).

The outer solar system presents an amazing array of colors and features, easily observed with even small telescopes, that are somewhat surprising in light of the expected cold (less than 200°K) temperatures there. Included here are the recent detections of such gases as C_2H_4 and PH_3, not expected from simple equilibrium cooling of a hot nebula (of solar composition). Thus non-equilibrium processes must be occurring in the solar system, as suggested by the above facts and by the temporal variations of the features (belts, zones, and spots) found on Jupiter. Such processes are probably stimulated by the interaction of energy from the sun (radiation) or the planetary interior (heat) with the gases in the atmospheres or on the surfaces. One possible source of this energy is the solar wind, in particular the protons therein. These particles can impinge upon the atmospheres or surfaces directly or from radiation belts (for Jupiter) and initiate chemical reactions. To investigate this concept, a number of laboratory simulations of the interactions of energetic protons with a variety of mixtures of CH_4, C_2H_6, NH_3, H_2O, H_2S, CO_2, CO, N_2, and PH_3 have been carried out. It is possible that proton initiated chemistry may account for some of the phenomena observed in the outer solar system, and in conjunction with other chemical processes can produce the necessary chromophores. A more complete and definite understanding of such processes will hopefully be achieved with the use of planetary probes, planned for the near future (the end of this decade). (Diss. Abstr. Int., B)

27092 NEW VISTAS IN PLANETARY RADIO ASTRONOMY. Alexander, J. K. Jr. (Goddard Space Flight Center, Greenbelt, MD). Sky Telesc.; 51: No. 3, 148-153 (Mar 1976).

In recent years the low-frequency radio spectra of Earth, Jupiter, and Saturn have been detected. The resemblances between the spectra, including spectral shape, half-power bandwidths, and sharp high- and low- frequency cutoffs, are discussed. Predictions concerning magnetic field strengths of the planets are made. (BJG)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 25566, 25734, 26082, 27158, 27160, 27161, 27164, 27165, 27171, 27174, 27175, 27178, and 27298.

27093 (AD/A-006402) GEOPHYSICS AND SPACE DATA BULLETIN. Volume XI, Number 3, Third Quarter, 1974. Special Repts. Carrigan, A. L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). Dec 1974. 276p. (AFCRL-SR-186; AFCRL-TR-74-0608). NTIS $8.75.

See also report dated Sep 1974, AD/A-001025.

This Bulletin is a quarterly publication that contains AFCRL contract and in-house data reported from sites throughout the world. The following types of data are contained within each issue: magnetometer, cosmic ray, elf noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for July, August, and September 1974. (GRA)

27094 (AD/A-006567) SUDDEN IONOSPHERIC DISTURBANCE GRID. Research and Development Report, 15 Sep 1973–15 Jun 1974. Rose, R. B.; Hill, J. R.; Bleiweiss, M. P. (Naval Electronics Lab. Center, San Diego, Calif. (USA)). 1 Dec 1974. 41p. (NELC-TR-1938). NTIS $3.75.

The technique described will allow controllers to quickly determine (1) whether a short wave fade in progress will affect any of their hf circuits, (2) the degree to which each circuit is affected, (3) alternative frequencies, and (4) alternative traffic routes available. The only required input parameter is 1–8A x-ray flux. The computer program continuously displays the LOF over any number of preselected hf transmission paths in predictive, real-time, or historical mode. The technique was designed primarily for naval commands which control hf systems covering large geographical areas, such as Communication Area Management Sections at Navy Communications Stations and HF Direction Finding Net Control. (GRA)

27095 (AD/A-007920) MODERN PHOTOCHEMICAL THEORY AND EXPLANATION OF THE BEHAVIOR OF THE ION CONCENTRATION ABOVE 100 km. Danilov, A. D.; Vlasov, M. N. 22 Jan 1975. Edited Translation of Mono. Fotokhimiya Ionizovannykh i Vozbuzhdennykh Chastits V Nizhnei Ionosfere, Leningrad, 1973, p1-190. (FTD-HC-23-2158-74). 305p. NTIS $9.25.

Modern problems of upper atmosphere photochemistry are examined, which are now mainly concentrated in the region of the lower ionosphere (50–200 km). The arrangement of the processes, which govern the behavior of ionized particles at different levels of the lower ionosphere, is presented and discussed. A detailed analysis is given of the variations in the ion composition and the connection between the behavior of neutral and ionized particles is studied. A detailed description is given for the new trends in atmospheric photochemistry, i.e., the study of the reactions with excited particles. Both sides of the problem are considered: the photochemistry of excited atoms and molecules itself, and the contribution of these particles to such important questions of the physics of the ionization, electron balance, and nitric oxide formation. (GRA)

27096 (AD/A-008098) A POCKET MANUAL OF THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE EARTH'S ATMOSPHERE. Handbook. Blank, C. A.; Baurer, T.; Bortner, M. H.; Feryok, A. A. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). 1 Jul 1974. Contract DNA001-73-C-0146. 292p. NTIS $8.75.

This publication is a pocket-sized extract of information contained in "The Reaction Rate Handbook" (DNA 1948H), Revised Edition, and other sources, and is a compendium of useful data for the convenience of atmospheric chemists, physicists, etc. The manual is broken down into five major categories; viz, Atmospheric Characteristics, Chemical Reactivity Data, Radiation Data, Electromagnetic Propagation Data, and Constants and Conversion Factors. (GRA)

27097 (ESRO-SP-107, pp 7-9) BRITISH SOUNDING-ROCKET PROGRAM AND THE ESRANGE SPECIAL PROJECT. Eastwood, G. W. (Science Research Council, Slough, Eng.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92 – Neuilly-sur-Seine (France)).

British participation in the Esrange Special Project has developed very satisfactorily since the program was reviewed at the last Esrange Symposium. Two campaigns have been undertaken at Andoya and several more are projected. A major campaign was held from October to December 1973 to investigate auroral substorms. A second campaign includes an experiment to investigate the fine structure of auroral electron and proton precipitation and one to determine the electric field vector in the ionosphere during an aurora. (auth)

27098 (ESRO-SP-107, pp 23) FUTURE DANISH SOUNDING-ROCKET ACTIVITIES. Jorgensen, T. S. (Meteorological Inst., Copenhagen). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92 – Neuilly-sur-Seine (France)).

Danish ionospheric research by means of rockets will probably mainly be carried out from Sondre Stromfjord Rocket Range in Greenland, from where, since the range's establishment in 1971, two Nike/Apaches and three Nike/Tomahawks have been launched in national and international programs. The aims of the rocket experiments have been to investigate electric fields in the polar-cap region under substorm conditions, and electric as well as magnetic fields and particles in the dayside polar cusp. (auth)

27099 (ESRO-SP-107, pp 25-26) AUSTRIA'S SOUNDING-ROCKET AND SCIENTIFIC-BALLOON PROGRAM. Ortner, J. (Austrian Space Agency, Vienna). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92 – Neuilly-sur-Seine (France)).

27100 (ESRO-SP-107, pp 43-45) SOUNDING-ROCKET PROGRAM DURING THE IMS AT UPPSALA IONOSPHERIC OBSERVATORY. Holback, B. (Uppsala Ionospheric Observatory). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92 – Neuilly-sur-Seine (France)).

The sounding-rocket program at Uppsala Ionospheric Observatory (UIO) is divided into two main parts; i.e., measurements of parameters in the lower ionosphere important for modelling, and investigations of vertical coupling between the ionosphere and the magnetosphere along the geomagnetic field lines, and of related phenomena. (auth)

27101 (ESRO-SP-107, pp 187-193) EXPERIENCES WITH TELEMETRY AND LOCALISATION OF BALLOONS DRIFTING FROM SCANDINAVIA TO GREENLAND, WITH SUGGESTIONS FOR COORDINATED CAMPAIGNS DURING THE GEOS PERIOD. Trefall, H. (Univ. of Bergen). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92 – Neuilly-sur-Seine (France)).

The long-duration flight capabilities of modern stratospheric balloons, coupled with their westward drift in the summer, make it possible to perform balloon recordings over the region from Scandinavia to Greenland with launchings from Scandinavian stations only, the VHF radio range of a balloon-borne transmitter being sufficient to cover the region mentioned from land-based telemetry stations only. Furthermore, balloon positions all the way from Scandinavia to Greenland can now be determined by means of the CONSOL navigation system. This allows the coordination of balloon recordings and GEOS satellite measurements even when the satellite is located on a field line that comes

down between Scandinavia and Greenland. In particular, the geomagnetically conjugate point when the satellite is close to the geomagnetic equator falls in the sea between Norway and Iceland, but the surrounding area can easily be well covered by balloon measurements if they are well co-ordinated and conducted on a sufficiently large scale. (auth)

27102 (ESRO-SP-107, pp 205-210) PROPOSED UK HIGH-LATITUDE ROCKET CAMPAIGN IN LATE 1976/EARLY 1977. Thomas, G. R.; Bryant, D. A. (SRC, Appleton Lab., Slough, Eng.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92 – Neuilly-sur-Seine (France)).

The second major UK high-latitude rocket campaign is scheduled for late 1976/early 1977 at Andoya. The proposed experiments provide a comprehensive set of measurements of high-latitude phenomena and include studies of the sources and acceleration of auroral particles, the stability of plasma flow, wave-particle interactions, and the response of the atmosphere and ionosphere to enhanced geomagnetic activity. These experiments require coordinated launchings of high-altitude (740 to 950 km) and small, medium-altitude (320 to 370 km) rockets. The provisional campaign plan includes four Skylark 12's (with Skylark 11 as a possible substitute), one Skylark 7 (with Skylark 6 as a possible substitute), and five Fulmars (with Skylark 10A as a possible substitute). Some of the experiments require simultaneous measurements by GEOS in the European sector (early 1977), but the remainder could be carried out in late 1976. (auth)

27103 (ESRO-SP-107, pp 221-224) ROCKET-BORNE SPECTROMETER FOR HIGH-RESOLUTION STUDIES OF ATMOSPHERIC EMISSIONS. Henrist, M.; Duysinx, R.; Jamar, J.; Macau, J. P. (Univ., Liege). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27104 (ESRO-SP-107, pp 225-232) DETERMINATION BY TRIANGULATION OF THE REGIONS WHERE WHISTLERS EMERGE FROM THE IONOSPHERE. Rycroft, M. J.; Jarvis, M. J.; Strangeways, H. J. (Univ. of Southampton, Eng.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

Observations made on 10 July 1972, using four goniometer (direction-finding) VLF receivers established in eastern Canada, have been analysed. The regions where multicomponent, two-hop whistlers emerge from the ionosphere into the earth-ionosphere waveguide have been found by triangulation, for the first time. For recordings made before the total solar eclipse, the L-values of the whistler exit points determined by triangulation are consistently lower, by ~0.7 of an L-value, than those determined from their nose frequencies. This discrepancy cannot be fully accounted for by the effect of the ring current. In order to explain it, it is postulated that on this occasion the electron-density trough in the topside ionosphere lies at a lower L-value than that of the plasmapause. Ray-tracing studies show that, on the high-latitude side of the trough, the waves are refracted to higher L-values before becoming ducted. Thus the multigoniometer technique is proving to be a powerful method of studying both temporal and spatial variations of the ionospheric and magnetospheric plasmas. Networks of goniometers should be established during IMS. (auth)

27105 (ESRO-SP-107, pp 233-237) ROCKET OBSERVATIONS OF SMALL-SCALE IRREGULARITIES IN THE AURORAL F-REGION. Moe, T. E. (Norwegian Inst. of Cosmic Physics, Oslo); Egeland, A.; Holtet, J. A.; Evans, D. S.; Ecklund, W. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

Some recent, in-situ, ACE-field measurements which strongly indicate the existence of narrow, irregular ducts closely related to boundaries of auroral arcs are presented and discussed. (auth)

27106 (ESRO-SP-107, pp 239-246) ION PRODUCTION AND THE EFFECTIVE ELECTRON LOSS COEFFICIENT IN AN REP EVENT. Jacobsen, T. A. (Univ., Graz); Friedrich, M.; Riedler, W. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

The precipitation of low-energy electrons and the density of thermal electrons have been measured simultaneously in a relativistic electron precipitation (REP) event on a daylight rocket flight from Andøya, Norway (L = 6). The ion production q and the effective electron loss coefficient $a_{eff} = q/N_e^2$ are deduced, also using data already published by Matthews & Simons [1973]. An interpretation of the measurements in terms of a generalised two-ion model is presented. (auth)

27107 (ESRO-SP-107, pp 247-254) RESONANCES AND NONLINEARITIES OBSERVED IN A WAVE EXPERIMENT ON A MOTHER-DAUGHTER ROCKET. Folkestad, K. (Norwegian Defence Research Establishment, Kjeller); Troim, J.; Bording, J. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

Results of a wave-propagation experiment conducted on a mother-daughter rocket in the ionospheric F-region are presented and discussed. Theoretically derived dispersion relations are employed to identify characteristics of the data. In considering nonlinear phenomena revealed by the observations, "weak" turbulence appears to be a potential driving mechanism. (auth)

27108 (ESRO-SP-107, pp 255-260) TIME-DEPENDENT EFFECTS OF A PARALLEL ELECTRIC FIELD. Johnstone, A. D. (UCL Mullard Space Science Lab., Surrey, Eng.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

The purpose of the model calculations presented is to find an explanation for some observations of precipitating electrons made by a sounding rocket [Johnstone & Davis, 1974]. Many of the features of the event observed by the rocket indicated that its cause was an electric field parallel to the magnetic field lines. The other features, though not contradicting this interpretation, could not immediately be explained. (auth)

27109 (ESRO-SP-107, pp 267-277) COMPARISON OF LIGHT EMISSIONS AND AURORAL PARTICLES IN A POST-BREAK-UP AURORA. Lundin, R.; Anderson, L. E. (Kiruna Geophysical Inst., Sweden). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

Auroral particle measurements made on a rocket, launched from Esrange on 27 October 1970 at 20.34.22 UT, in the recovery phase of a substorm, are compared with ground-based photometer observations. For most of the flight the photometer signals at 3914 Å, 4278 Å and 5577 Å and the electron fluxes measured by the rocket-borne particle detectors showed exponentially decreasing intensities, suggesting diffusion of newly injected particles on closed geomagnetic field lines. The pitch-angle distribution of electrons in the energy range 1-12 keV was predominantly isotropic over the upper hemisphere indicating that electrons were strongly scattered into the loss cone. Electrons of higher

energies (> 55 keV) were only sampled in the pitch-angle range ~70° to ~110°, i.e., more or less outside the loss cone. This excluded the possibility of investigating the diffusion rate at higher energies. However, from minimum-lifetime calculations it seems likely that the scattering mechanism was effective even for energies > 55 keV, but with decreasing efficiency for higher energies. Two burst-like events with field-aligned electron pitch-angle distributions are discussed. According to the phase-density spectrums obtained, the first event could be explained by a field-aligned potential drop; the second event was quite different in nature and the field-aligned electron distribution could not be attributed unambiguously to such a potential drop. (auth)

27110 (ESRO-SP-107, pp 295-300) PROJECT "PORCUPINE": A STEP TOWARDS UNDERSTANDING THE AURORA. Haerendel, G. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching, Ger.); Klett, R. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27111 (ESRO-SP-107, pp 309) CO-ORDINATION OF ROCKET EXPERIMENTS FOR THE PERIOD 1 JANUARY 1977–31 DECEMBER 1978. Egeland, A. (Norwegian Inst. of Cosmic Physics, Oslo); Soraas, F. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27112 (LUIP-CR–75-03) ANALYSIS OF PHOTOMETRIC MEASUREMENTS IN NUCLEAR EMULSIONS ON TRACKS OF HEAVY COSMIC RAY PARTICLES. Behrnetz, S. (Lund Univ. (Sweden). Fysiska Institutionen). Apr 1975. 32p. Dep. NTIS (US Sales Only) $4.00.

An investigation of the chemical composition of the cosmic radiation has been made for the elements with $Z \geq 14$. Tracks of heavy primaries were registered in three stacks of nuclear emulsions during balloon flights from Fort Churchill, Canada, at about 2.7 g/cm^2 of residual atmosphere. This report is concerned with the analysis of the last two stacks. 300 stopping tracks with $Z \geq 12$ were measured with a wide slit nuclear track photometer. The photometer data were subject to different corrections, in which the last two mm of the tracks were treated separately. A shear effect in the emulsions depending on the distance to the edge is also discussed. A linear charge calibration is used. This can be supported by a theoretical track formation calculation. 179 tracks with $Z \geq 12$ have been selected for a charge spectrum. (auth)

27113 (PB–238839) REPORT OF NRL PROGRESS. (Naval Research Lab., Washington, D. C. (USA)). Oct 1974. 54p. NTIS $4.25.

Contents: Research at NRL on theoretical and numerical simulation studies of ionospheric irregularities; Progress notes–(Antennas, Electronics, Metallurgy, Ocean sciences, Ocean technology, Optical radiation, Radar, Space science); Papers by NRL staff members; Patents; Reader service. (GRA)

27114 ATMOSPHERIC DENSITY AT HEIGHTS BETWEEN 200 AND 300 km FROM DRAG ON INTERKOSMOS SATELLITES. Prokes, M. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 26: No. 5, 306-315(1975).

Densities derived from the change of orbital periods and density scale heights derived from the decrease of orbital periods are presented for the satellites Interkosmos 3, 4, 5, 7, 8, and 9 and compared with existing models. An appraisal of the suitability of the Interkosmos satellites for determining the upper atmosphere characteristics was made. (auth)

27115 ROTATIONAL SPEED OF THE UPPER ATMOSPHERE DETERMINED FROM ORBITAL INCLINATIONS OF INTERKOSMOS SATELLITES. Sehnal, L. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 26: No. 5, 300-306(1975).

The velocity of the rotation of the atmosphere is computed from the secular changes of the inclination of the orbits of the Interkosmos satellites, the elements of which are expressed as polynomials. After numerical integration of the formula for the change of the inclination, the theoretical curves are compared to the observed values. Good results are obtained from the data of the Interkosmos 3, 5, and 9 satellites. (auth)

27116 HEAD ECHOES AND SOLAR ACTIVITY IN THE GEMINID PERIOD. Pecina, P. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 26: No. 5, 288-293(1975).

The occurrence of head echoes in dependence on solar activity in the Geminid period 1959–1969 is examined. All considerations refer to the interval 22 h–06 h U.T. Solar ionizing radiation is assumed to be either of X-ray and ultraviolet, or corpuscular radiation nature. The former is characterized by correlating the solar microwave flux F and the latter by A_p and K_p indices. A comparison of the courses of the indices, mentioned above, with relative head echo rates on days of observation in each year as a function of solar longitude is not possible. A comparison within the 11-year solar cycle does not lead to the conclusion that in the interval 22 h–06 h U.T. the corpuscular radiation acts mainly on the head echo phenomenon. A definite answer to the question of the nature of the effective radiation will be possible if radar observations for more solar cycles and longer time interval is available. (auth)

27117 *E* REGION ION DRIFTS AND WINDS FROM INCOHERENT SCATTER MEASUREMENTS AT ARECIBO. Harper, R.M. (National Astronomy and Ionosphere Center, Arecibo Observatory, Arecibo, Puerto Rico 00612); Wand, R.H.; Zamlutti, C.J.; Farley, D.T. J. Geophys. Res. 81: No. 1, 25-35 (1 Jan 1976).

Ion velocity and temperature measurements at Arecibo for two winter days were analyzed to determine the large-scale dynamical structure of the *E* region. Southward neutral winds were derived directly from the ion velocity, while the southward electric field was obtained with a reasonable extrapolation of the measured ion-neutral collision frequency. Eastward winds were estimated after assuming a model eastward electric field taken from previous *F* region measurements at Arecibo. The main results are as follows: (1) Large oscillations in the ion drifts, neutral winds, and temperatures were present on the days of observation. The oscillations possessed a characteristic downward phase progression and dominant periods that were near semidiurnal. (2) Wind and temperature amplitudes were 40–100 m/s and 30°–60°K, respectively. Vertical wavelengths for a semidiurnal period were about 50 km. The calculated southward electric fields are typical of daytime *F* region values at Arecibo, −1 to −2 mV/m. (3) The observed semidiurnal amplitudes, phases, and vertical wavelengths of the wind and temperature oscillations do not closely match the predictions of classical tidal theory or the theory of Lindzen and Hong which includes dissipation and background winds. (auth)

27118 ON A THRESHOLD ELECTRIC FIELD ASSOCIATED WITH THE 398-MHz DIFFUSE RADAR AURORA. Tsunoda, R.T.; Presnell, R.I. (Stanford Research Institute, Menlo Park, California 94025). J. Geophys. Res. 81: No. 1, 88-96 (1 Jan 1976).

In this paper we address the question of whether auroral echoes are dependent on the ionospheric electric field. This question naturally arises from the concept of a plasma instability as the source mechanism producing the electron density irregularities responsible for the auroral echoes. Using the data from a backscatter radar located at Homer, Alaska, and the Chatanika incoherent scatter radar in a joint experiment, we show that there is a distinct dependence of the occurrence of diffuse auroral echoes on a threshold electric field strength. The threshold value for the 398-MHz radar aurora is shown to be approximately 30 mV/m. When the electric field strength is greater than 30 mV/m, the auroral echo strength is shown to be always positively correlated with the electric field strength, regardless of the mean electron density. On the other hand, the auroral echo strength is not always positively correlated with the electron density. The results are shown to be consistent with the quasi-linear plasma instability theory of Sudan et al.(1973) and Greenwald (1974). (auth)

27119 COORDINATED ATS 5 ELECTRON FLUX AND SIMULTANEOUS AURORAL OBSERVATIONS. Mende, S.B.; Shelley, E.G. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). J. Geophys. Res. 81: No. 1, 97-110 (1 Jan 1976).

All-sky camera (ASCA) observations were made at the field line conjugate of the ATS 5 satellite. The field of view of these cameras covered the region of the magnetosphere from L=5 to L=11 at the approximate longitude of the ATS field line conjugate. With this coverage, definite statements can be made concerning the correlation of the auroras observed by the ASCA's and the magnetospheric trapped fluxes. In general, auroral forms are not simply correlated with the synchronous altitude electron fluxes. The presence of hot plasma at the ATS 5 satellite is a necessary but not sufficient condition for the occurrence of local auroras. On quiet days the hot plasma does not penetrate into the magnetosphere far enough to reach the ATS 5 orbit. Under these conditions, no auroras are observed at the field line conjugate, but auroras are usually observed on higher-latitude field lines. On more disturbed days, auroral arcs are observed at lower latitudes when the plasma sheet penetrates into the ATS 5 orbit. There is no general correlation between the intensity of the trapped electron fluxes observed by ATS 5 and the intensity of auroras observed by the ASCA's. Auroral displays exhibit very fast fluctuations, whereas the ATS 5 electron fluxes change on a much slower time scale. However,

significant qualitative correlation between the ASCA data and the trapped fluxes is observed when a local plasma injection event occurs near ATS 5. The clearest signature of the injection event is magnetic and is most pronounced as a recovery of a negative bay in the north-south component of the field at the ATS 5. The local injection generally produces structured auroras such as breakup events and sometimes westward-traveling surges. A significant correlation is observed with the intensification of a diffuse uniform glow accompanying the structured auroral activity. (auth)

27120 HELIUM ISOTOPES IN AN AURORA. Bühler, F. (Physikalisches Institut, University of Bern, Bern, Switzerland); Axford, W.I.; Chivers, H.J.A.; Marti, K. J. Geophys. Res. 81: No. 1, 111-115 (1 Jan 1976).

Aluminum and platinum foils were flown into two bright auroras and subsequently recovered. They were then analyzed for traces of trapped noble gases in a sensitive high-resolution mass spectrometer. In this paper we report the detection of ^{3}He and confirm measurements of the ^{4}He flux reported in a previous paper. The ^{4}He:^{3}He ratio in the first (brighter) aurora was 2950±250. This ratio is only slightly higher than the average solar wind ratio of 2350 and since the atmospheric ratio is grossly different (250 times larger), establishes the solar wind as the principal source of auroral helium, at least in the aurora concerned. The result supports earlier suggestions that auroral precipitation is one of the main sources of the ^{3}He in the terrestrial atmosphere. Current estimates of ^{3}He sources and loss rates are found to be consistent with a balanced atmospheric ^{3}He budget. (auth)

27121 MEASUREMENTS OF FIELD-ALIGNED CURRENTS IN A MULTIPLE AURORAL ARC SYSTEM. Sesiano, J.; Cloutier, P.A. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). J. Geophys. Res. 81: No. 1, 116-122 (1 Jan 1976).

A rocket-borne experiment to study the currents associated with a system of multiple auroral arcs was conducted at Poker Flat, Alaska, at 1122 UT on February 2, 1972. The magnetic field in the vicinity of the auroral system was measured with a cesium vector magnetometer. Possible configurations were inferred by constructing model current systems that reproduced the magnetic field variations measured along the flight path. The data are interpreted in terms of a model current system consisting of two eastward electrojets and one westward electrojet and three pairs of oppositely directed Birkeland sheet currents, all lying in a plane approximately parallel to the auroral arcs. Sheet thicknesses ranged from 20 to 60 km and current densities from 10 to 45 μA/m^2; the electrojet currents ranged from 1000 to 2000 A. A possible alternate model consisted of four pairs of sheets whose thicknesses range from 10 to 40 km with current densities from 10 to 90 μA/m^2. There was quite good agreement between the locations of the visual arcs and the upward current sheets. The over-all current configuration is discussed in view of the theoretical models constructed by Atkinson and Sato and Holzer and of other observations. (auth)

27122 NONLINEAR PRODUCTION OF SUPRATHERMAL TAILS IN AURORAL ELECTRONS. Matthews, D.L.; Pongratz, M.; Papadopoulos, K. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). J. Geophys. Res. 81: No. 1, 123-129 (1 Jan 1976).

Differential energy spectra of electrons observed in an auroral breakup show evidence that an incident electron beam of energy E=6–13 keV, width of 2–5 keV, and variable intensity was stabilized over a period of at least several minutes by the oscillating two-stream instability in the manner previously described by Papadopoulos and Coffey. The critical observed feature predicted by these authors' calculation is a tail with differential flux $dj/dE \propto E^{-0.5}$. This tail is much too intense to be attributed to the effects of collisions with atmospheric constituents. It is possible that the tail is part of the beam itself, i.e., produced higher up, but there are at least two arguments against this: first, the observations indicate that the tail approaches isotropy, whereas the beam is mostly downcoming, and second, the tail is observed as low as 130 km; the portion of the tail below 1.5 keV would have been absorbed by the atmosphere at greater heights if it had been incident from above. The observations support the hypothesis that the tail electrons are produced locally and by the proposed stabilization process. Implications are briefly discussed. (auth)

27123 RADAR OBSERVATIONS OF TWO-DIMENSIONAL TURBULENCE IN THE EQUATORIAL ELECTROJET, 2. Fejer, B.G.; Farley, D.T. (School of Electrical Engineering, Cornell University, Ithaca, New York 14850); Balsley, B.B.; Woodman, R.F. J. Geophys. Res. 81: No. 1, 130-134 (1 Jan 1976).

Observations with an altitude resolution of about 1 km were made with the large, vertically directed 50-MHz radar system at the Jicamarca Radar Observatory during the day, when the electrojet was strong. Type 1 ('two stream') echoes were seen in a limited range of altitudes, with Doppler shifts corresponding to upward and downward motion at the acoustic velocity. Most of the radar returns were due to type 2 echoes, however. The direction of motion of the type 1 waves sometimes reversed in as little as 1 s, supporting a turbulent model of the electrojet region. During the day the upgoing type 1 waves were observed to be somewhat more easily excited than the downgoing waves, an effect similar to an east-west asymmetry noted in earlier studies. The correspondence between the Jicamarca radar observations and rocket measurements in India is discussed. (auth)

27124 ELECTRON PRECIPITATION IN THE MORNING SECTOR OF THE AURORAL ZONE. Jentsch, V. (Max-Planck-Institut für Aeronomie, Institut für Stratosphärenphysik, Lindau, Germany). J. Geophys. Res. 81: No. 1, 135-146 (1 Jan 1976).

Auroral electron precipitation in the morning sector is assumed to be the result of an electromagnetic cyclotron instability of a particle distribution that evolves adiabatically as its constituent electrons drift eastward from a source near midnight. The adiabatic distribution is calculated by using Green's function in various magnetospheric field models, and the corresponding growth rates for whistler mode waves are calculated by the method of Kennel and Petschek (1966). The region of maximum calculated wave growth corresponds spatially and temporally to the region of maximum observed electron precipitation only when the magnetospheric electric field is included realistically in the model. (auth)

27125 CHARACTERISTICS OF AURORAL PROTON PRECIPITATION OBSERVED FROM SOUNDING ROCKETS. Miller, J.R. (Department of Physics, York University, Toronto, Ontario, Canada); Whalen, B.A. J. Geophys. Res. 81: No. 1, 147-154 (1 Jan 1976).

In the following article a summary of auroral proton observations from 12 sounding rockets launched from Churchill Research Range is presented. Although these rockets were launched into different auroral conditions and at various local times, certain characteristics were observed in all flights. Energy spectra were peaked in the 5- to 10-keV energy intervals with typical intensities near 10^5 cm^{-2} s^{-1} sr^{-1} keV^{-1}. Proton pitch angle distributions in the loss cone were isotropic at all energies less than 20 keV. At higher energies, distributions were either isotropic or anisotropic peaked near 90° pitch angle. Temporal and spatial structure was observed in proton precipitation with typical time scales of the order of 100 equatorial gyroperiods and scale lengths of the order of 100 gyrodiameters. No obvious electron-proton correlations were apparent in any of the data. Observations of interactions of the primary proton beam with the neutral atmosphere are presented. Beam spreading effects due to charge exchange interactions are demonstrated, and equilibrium fractions for protons in the atmosphere are measured and compared with relevant laboratory observations. The implication of these results concerning auroral proton source regions and precipitation mechanisms is discussed. (auth)

27126 ELECTRON PRECIPITATION IN THE POSTMIDNIGHT SECTOR OF THE AURORAL ZONES. Frank, L.A.; Saflekos, N.A.; Ackerson, K.L. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242). J. Geophys. Res. 81: No. 1, 155-167 (1 Jan 1976).

Comprehensive measurements of the angular distributions and energy spectra of electron intensities within the energy range 50 eV $\leq E \leq$ 15 keV with electrostatic analyzer arrays on board the low-altitude satellite Injun 5 are reported for the postmidnight sector of the auroral zones during the high-intensity events accompanying magnetic substorms. Precipitation features on closed terrestrial field lines well equatorward of the trapping boundary for energetic electrons with $E>45$ keV are examined. No evidence of maxima in the differential energy spectra or of strongly field-aligned currents, $j_\parallel > j_\perp$, which are indicative of quasi-static electric fields aligned parallel to the geomagnetic field, was found in our series of measurements within the above energy range. Precipitation of low-energy electron intensities fluctuated on time scales of $\gtrsim 2$ s as viewed at the satellite position. This precipitation was characterized by isotropy for all pitch angles outside the atmospheric backscatter cone. Maximum precipitated energy fluxes were several ergs (cm^2 s sr)$^{-1}$. This region of electron precipitation is associated with the diffuse aurora and with pulsating aurora in the postmidnight sector. Similar variations of the energetic electron intensities with $E>45$ keV were observed in the regions of fluctuating energy fluxes of low-energy electrons associated with auroral luminosity. In general, the increases of energetic electron intensities were not coincident with those of the principal energy fluxes into the atmosphere, except when the average electron energy for the energy fluxes was unusually high, i.e., in the 10-keV range. Precipitation of electron intensities within the energy ranges 50 eV to 15 keV and >45 keV is consistent with strong pitch angle diffusion of electron intensities near or at the magnetic equator by high-frequency wave turbulence, the effectiveness of which is modulated by perturbations attributable to micropulsations to yield the rapid fluctuations encountered over the postmidnight auroral zone. (auth)

27127 MODELING HF DOPPLER EFFECTS OF GEOMAGNETIC SUDDEN COMMENCEMENTS. Huang, Y. (Telecommunications Laboratories, Ministry of Communications, Chung-Li, Taiwan, Republic of China). J. Geophys. Res. 81: No. 1, 175-182 (1 Jan 1976).

A model has been proposed to explain the ionospheric effects of the sudden commencements as measured with a Doppler sounder. The model consists of two different sources of electric fields generated in the ionosphere during the sudden commencement: a westward electromagnetically induced electric field generated in the *F* region due to the change of magnetic field and an eastward dynamo electrostatic field set up in the dynamo region and transferred along the geomagnetic field lines to the *F* region. The change of Doppler frequency shifts during the sudden commencement (ssc) is due to the vertical motion of the charged particles forced by these two opposing electric fields. The theoretical Doppler shifts were calculated on the basis of this model, and four observed ssc's and scf's were used to check the validity of the model. (auth)

27128 ANALYSIS OF THE BACKSCATTER SPECTRUM IN AN IONOSPHERIC MODIFICATION EXPERIMENT. Kim, H.; Crawford, F.W.; Harker, K.J. (Institute for Plasma Research, Stanford University, Stanford, California 94305). J. Geophys. Res. 81: No. 1, 193-198 (1 Jan 1976).

The purpose of this study is to compare predictions of the backscatter spectrum, including effects of ionospheric inhomogeneity, with experimental observations of incoherent backscatter from an artificially heated region. Our calculations show that the strongest backscatter echo received is not from the reflection level but from a region some distance below (about 900–1100 m for an experiment carried out at Arecibo). By taking the standing wave pattern of the pump properly into account the present theory explains certain asymmetrical features of the upshifted and downshifted plasma lines in the backscatter spectrum. (auth)

27129 A MECHANISM FOR DRIVING THE GROSS BIRKELAND CURRENT CONFIGURATION IN THE AURORAL OVAL. Rostoker, G. (Institute of Earth and Planetary Physics, University of Alberta, Edmonton, Alberta, Canada); Boström, R. J. Geophys. Res. 81: No. 1, 235-244 (1 Jan 1976).

Birkeland (field-aligned) sheet currents flowing into and out of the auroral oval as reported by Zmuda and Armstrong (1974) are integrally associated with convective motion of plasma in the magnetotail. It is demonstrated that these currents can be driven by energy supplied by the braking of this convective motion of the plasma sheet particles as they drift toward the flanks of the magnetosphere. In the ionosphere the sheet currents close as Pedersen currents, resulting in the dissipation of power, while far from the earth the closure currents, which provide the braking force for the plasma, flow in the plasma sheet approximately normal to the neutral sheet out to radial distances of about 80 R_E. During periods of moderate magnetospheric activity the Birkeland currents result in a rate of dissipation of convective energy of the order of 10 GW. (auth)

27130 SOLAR EUV FLUX VARIATION DURING A SOLAR CYCLE AS DERIVED FROM IONOSPHERIC MODELING CONSIDERATIONS. Roble, R.G. (National Center for Atmospheric Research, Boulder, Colorado 80303). J. Geophys. Res. 81: No. 1, 265-269 (1 Jan 1976).

Calculations in modeling the general ionospheric structure observed during solar minimum and solar maximum suggest that the Hinteregger (1970) solar EUV flux values are adequate for modeling the mid-latitude ionospheric structure during solar minimum. However, these flux values should be doubled for modeling solar maximum conditions. The calculations also suggest that the atomic oxygen density at 120 km was approximately a factor of 2 lower during solar cycle minimum than during solar cycle maximum. (auth)

27131 INTRODUCTION TO THE IONOSPHERE AND MAGNETOSPHERE. Ratcliffe, J. A. New York; Cambridge University Press (1972). 265p. $6.95.

Processes involved in the formation of the ionosphere and magnetosphere are discussed. The nature of the ionospheric layers and phenomena such as geomagnetism, ionospheric currents, ionospheric storms, and solar disturbances are covered. A treatment of the principles governing collisions, diffusion, movements of charged particles in magnetic fields, and electromagnetic, hydromagnetic, and electro-acoustic waves is also included. The remaining portion of the book deals with experimental methods using radio waves and space vehicles. 176 refs. (BJG)

27132 MEASUREMENT OF LOW-ENERGY ELECTRONS IN THE DAY AIRGLOW AND DAY SIDE AURORAL ZONE FROM ATMOSPHERE EXPLORER C. Doering, J. P. (John Hopkins Univ., Baltimore); Peterson, W. K.; Bostrom, C. O.; Armstrong, J. C. J. Geophys. Res.; 80: No. 28, 3934-3944 (1 Oct 1975).

The photoelectron spectrometer experiment on Atmosphere Explorer C has obtained high-resolution spectra of the energy distribution of 2- to 500-eV electrons in the thermosphere at altitudes above 155 km. The photoelectron spectrum in the day airglow has been measured in detail over a wide range of altitude, latitude, and local time. Structure observed near 27 eV is assigned to photoelectrons ejected from atomic oxygen by the intense solar He II (304 A) radiation. The photoelectron energy distribution is shown to have a sharp cutoff near 60 eV. In addition to the day airglow data, spectra are also presented showing low-energy (100–500 eV) electron precipitation near the polar boundary of the auroral oval at magnetic local times near 0830. The precipitation is a low-energy inverted "V" type event occurring over an extremely narrow range of invariant latitude (DELTA LAMBDA approximately 0.3°). The electron stream is about 50 eV wide at the half-maximum intensity points and changes in energy from 100 to 500 eV. Instrument calibration in the laboratory, performance of the experiment in orbit, and plans for further analysis of the large body of data which now exists are discussed in detail. (auth)

27133 EXISTENCE OF ROSSBY WAVES IN THE IONOSPHERE. Panchev, S.; Stanev, E. Bulg. J. Phys.; 1: No. 1, 26-32(1975). (In Russian).

Starting from the equations of motion, the vorticity equation is derived. It is shown that this nonlinear partial differential equation has an exact analytical solution describing a decaying wave motion with phase velocity, interpreted as an analog of the Rossby waves in the lower atmosphere. The linearized equation is also studied, but it has more complex solution which is less precise than the previous one. The conclusion is drawn, that Rossby waves can exist in the ionosphere, and for their description one could use the nonlinear equation instead of the linear one. (auth)

27134 EFFECT OF SOLAR ACTIVITY ON GEOPHYSICAL PROCESSES. Velinov, P. Bulg. J. Phys.; 1: No. 1, 51-77(1975). (In Russian).

A number of questions, related to the effect of solar activity on the courses of geophysical processes are examined. The effect of abrupt changes in the solar activity on a number of ionospheric and geomagnetic parameters is studied and it is shown that these maximal variations cause corresponding turning points in the courses of geophysical processes. This investigation covers also a number of processes of the solar-terrestrial physics: the galactic cosmic rays, comets, the noctiluscent clouds, the aurora borrealis, the rotation of the Earth, earthquakes and movement of the pole, and it is quantitatively demonstrated that the processes in the area, located closer to the Sun are influenced to a higher degree by the solar activity. A new matrix method in the analysis of solar-terrestrial relationships, taking into account the comprehensive influence of all elements, is introduced and an application of the matrix analysis is indicated. (auth)

27135 SELF-ACTION OF A POWERFUL ELECTROMAGNETIC PULSE IN THE UPPER ATMOSPHERE. Vas'kov, V. V.; Getmantsev, G. G.; Karavanov, V. S.; Korobkov, Yu. S.; Mityakov, N. A.; Rapoport, V. O.; Ryzhov, V. A.; Trakhtengerts, V. Yu.; Shlyuger, I. S.; Yurin, K. I. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 10, 1426-1429(1975). (In Russian)

The results of experimental investigations of amplitude and phase self-modulation of a radio pulse in the ionosphere are presented. (auth)

27136 CORRELATION OF THE RATE OF OCCURRENCES OF WHISTLING ATMOSPHERICS WITH OPERATION OF A POWERFUL SUPER-LONG WAVE STATION. Obolenskii, L. M.; Yashin, Yu. Ya. (Gorky State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 10, 1430-1433(1975). (In Russian)

The results of measuring the rate of occurrences of whistling atmospherics in the presence and in the absence of SLM station signals in the ionosphere are given. (auth)

27137 PARAMETRIC INSTABILITY OF VLF WAVES IN THE UPPER IONOSPHERE. Grach, S. M. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1627-1637(1975). (In Russian)

A parametric instability of quasi-monochromatic VLF waves in the upper ionosphere is considered. It is shown that the initial signal scatters into a low-frequency plasma wave and decays into low-frequency and ion-cyclotron waves most effectively. A parametric interaction between two whistlers and an ion-cyclotron wave is considered. The above processes may be responsible for excitation of the low-hybrid resonance in the ionosphere and magnetosphere of the Earth. (auth)

27138 RESULTS OF MEASURING THE ELECTRON DENSITY IN THE IONOSPHERIC D-REGION DURING SUDDEN IONOSPHERIC DISTURBANCES. Belikovich, V. V.; Benediktov, E. A.; Grishkevich, L. V.; Ivanov, V. A. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 8, 1094-1097(1975). (In Russian)

N (h)-profiles of the ionospheric D-region measured in Gorky for the period of 11 sudden ionospheric disturbances are given. Observations were carried out by the partial reflection method at the frequency f = 5.75 MHz. (auth)

27139 THEORY OF PROPAGATION OF MODIFIED ION-SOUND WAVES IN THE OUTER IONOSPHERE. Zhmur, L. E. (Gorky State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 8, 1098-1105(1975). (In Russian)

Starting from the mechanism described by Poverlein who suggests the occurrence of ion-sound waves in the outer ionosphere in the period of geomagnetic perturbations, the influence of ion and molecule collisions on these waves and gravity are considered. Consideration is made in the isothermal approximation with taking into account the external magnetic field and the condition of plasma magnetization. An expression is found for the velocity of plasma motion caused by a modified ion-sound wave. The efficiency of penetration of the given wave out of the outer ionosphere into F-region has been analyzed. (auth)

27140 HEIGHT OF AURORAL EARTH–IONOSPHERE WAVEGUIDE. Leonov, V. I. (Leningrad State Univ.). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1598-1602(1975). (In Russian)

Amplitude of the GBR (16.0 Kc/s) and that one of NAA (17.8 Kc/s) signals at Kamchatka during February–March 1973 are compared to apriori calculated values. In consequence, the conclusion is drawn on the possibility of very little reflection heights. At night the heights sometimes fall to 45–47 km. In the daytime the reflection occurs at 38–47 km. (auth)

27141 INHOMOGENEOUS STRUCTURE OF THE UPPER IONOSPHERE. Alimov, V. A.; Erukhimov, V. A.; Rakhlin, A. V.; Rubtsov, L. N. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1603-1606(1975). (In Russian)

The results are presented of investigation of the inhomogeneous structure of the upper ionosphere by a frequency-spaced SW signal reception method at the Dushanbe–Gorki trace. The long (3 hour duration) continuous observations of SW signal fluctuations permit to judge about a cloud, large-scale inhomogeneous ionospheric structure with the characteristic scale ~60 km. Auto- and cross-correlation processing (over ten minute intervals) of the signal records obtained led to a conclusion on a considerable nonstationarity of short wave scattering in the ionosphere in the most cases of that experiment. Statistical parameters of the signals (for stationary conditions) were compared with the corresponding dependences for the inhomogeneous ionospheric model as a phase screen. The characteristic scale of inhomogeneities is $l \sim 1$ km and the value of relative fluctuations of the electron density is $-\Delta N/N \sim 10^{-3}$. (auth)

27142 LARGE-SCALE HORIZONTAL WINDS IN THE IONOSPHERE IN THE PRESENCE OF VERTICAL VELOCITIES. Khantadze, A. G.; Gvelesiani, A. I.; Kurtskhaliya, E. G. (Inst. of Geophysics, Tbilisi, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1607-1613(1975). (In Russian)

The solution of simplified system of equations is given for the problem of a general circulation of the upper atmosphere with taken into account a time-periodic vertical velocity. The influence of the value and direction of the vertical velocity on rotation of the horizontal wind and its considerable role when the wind amplitude and phase changes with height and time is shown. (auth)

27143 INFLUENCE OF THE IONOSPHERE PARAMETERS ON RADIO WAVE ABSORPTION IN IONOSPHERIC WAVE CHANNEL. Matyugin, S. N. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1614-1618(1975). (In Russian)

Variations of absorption of a sliding mode in the ionospheric wave channel as a function of the parameters of E and F_2 regions and of interlayer ionization in twilight zone are considered. It is shown that at the frequency 20 MHz under the conditions considered the absorption value at round-the-world trace is 1,7–3,7 db. The propagation of a sliding mode is found to be energetically more useful at the deeper "valley." (auth)

27144 NATURE OF SMALL-SCALE IRREGULARITIES AND RADIO WAVE DIFFRACTION BY MULTI-LAYER WAVE STRUCTURE OF THE IONOSPHERE. Bakai, A. S.; Solodovnikov, G. K. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 11, 1619-1626 (1975). (In Russian)

Based on the analysis of experimental data on radio wave diffraction by small-scale irregularities, it is shown that the latter represent themselves as ion-sound waves propagating in wave layers of the ionosphere. The theory of radio wave diffraction by coherent multilayer wave structures is developed. Based upon the theory, the analysis of the experimental data is given and the scales of irregularities in wave layers are estimated. (auth)

27145 THEORY OF HEATING IN THE LOWER IONOSPHERE BY OBLIQUELY INCIDENT WAVES FROM A POWERFUL POINT TRANSMITTER. Maslin, N. M. (Cambridge Univ., Eng.). Proc. R. Soc. (London), Ser. A; 346: No. 1644, 37-57(14 Oct 1975).

In the study of wave interaction it is necessary to know the power absorbed per unit volume of the anisotropic ionospheric plasma, from the disturbing radio wave radiated by a powerful point transmitter. This depends on height, range and direction. The problem is first considered when there are only two obliquely upgoing waves. The two magnetoionic components that reach the same real point in the ionosphere are incident at different complex angles. They are added, with allowance for their relative phase, to give an interference pattern in three dimensions. The time average of the power absorbed per unit volume is found from the total electric intensity and the resulting current density. It is equal to minus the divergence of the time averaged Poynting vector. To study these effects and to illustrate the methods of calculation, a semi-infinite homogeneous cold electron plasma with a sharp lower boundary is used as a model of the ionosphere. Calculation for points in the magnetic meridian plane is simplest and is explained first. It is then shown that for other directions a similar method can be used by rotating the coordinate axes about the vertical through a suitable complex angle. The effect of including two further waves that have been reflected at a higher level is also studied. Some typical results are presented. (auth)

27146 IONOSPHERIC DISTURBANCE OF TYPE SEA IN HER RECORDING IN lf BAND. Preda, M.; Dinulesen, V. Bul. Inst. Politeh. Gheorghe Gheorghiu-Dej Bucur.; 37: No. 1, 99-108 (1975). (In Hungarian)

A type of SEA effect (sudden enhancement of atmospherics) is presented as a result of activity in the solar flare which is produced by ionizing radiations. A comparison is made between the enhancement of the H line and the time variation of the X radiation, and the development of the SEA effect. (auth)

27147 ELECTRON-ION ENERGY TRANSFER RATE. Itikawa, Y. (Tokyo Univ.). J. Atmos. Terr. Phys.; 37: No. 12, 1601-1602 (Dec 1975).

The rate is derived for the energy transfer between electrons and ions each having a Maxwellian velocity distribution but with a different temperature. The many-body effect of the charged particle interaction is correctly taken into account. A more precise expression for the Coulomb logarithm is given than that obtained when the Coulomb potential is simply truncated at the Debye length or when instead the shielded Coulomb potential is used. (auth)

27148 EXCITATION OF THE EARTH-IONOSPHERE WAVEGUIDES BY DOWNGOING WHISTLERS. III. Wave Normal Not in the Magnetic Meridian. Walker, A. D. M.; Lindsay, R. N. (Natal Univ., Durban, South Africa). J. Atmos. Terr. Phys.; 37: No. 12, 1599-1600(Dec 1975).

Calculations relating to the excitation of the Earth-ionosphere waveguide by downgoing whistlers carried out in previous papers are generalized to the case where the plane of incidence is not in the magnetic meridian. It is found that the results are very insensitive to the orientation of the plane of incidence. Thus previous results applying in the magnetic meridian plane can be applied to stations widely separated in longitude. In particular stations spaced in longitude by up to 2000 km should be able to receive the same whistlers. (auth)

27149 IMPROVED PHENOMENOLOGICAL MODEL OF IONOSPHERIC DENSITY. Chiu, Y. T. (Aerospace Corp., El Segundo, CA). J. Atmos. Terr. Phys.; 37: No. 12, 1563-1570 (Dec 1975).

A global representation of the large scale variations of ionospheric electron density with the annual, diurnal and solar activity cycles is described. The phenomenological model, requiring minimal computer storage space, is constructed from monthly-averaged hourly ionospheric sounding data from some 50 stations during the epoch 1957 to 1970, as provided by World Data Center (A). The model, describing noontime F2-layer critical frequencies to better than 2 MHz average maximum error and to better than 0.5 MHz root mean squared error, is particularly suitable for applications in space communication and ionosphere-atmosphere coupling studies. Magnetic dip angle and north-south asymmetry effects are incorporated in the model. It is shown that a "secular" variation of the ionospheric density exists in the epoch 1960 to 1971. The basis of comparison with data is broadened to include the 1958 to 1968 chronologies of 18 stations in addition to the original samplings of 50 stations. In addition, a modelling of the polar ionospheres is included. (auth)

27150 ANALYSIS OF NIGHT-TIME IONOGRAMS. Titheridge, J. E. (Auckland Univ., New Zealand). J. Atmos. Terr. Phys.; 37: No. 12, 1571-1574(Dec 1975).

The analysis of ionospheric h'(f) records can give appreciable

errors at night, when large amounts of ionization may be present with plasma frequencies less than the minimum recorded frequency f_{min}. The errors depend on both the total amount of low-density ionization, and on the ionization gradient near f_{min}. A simple, approximate allowance for both effects is obtained by using the virtual height of an extraordinary ray which reflects at a plasma frequency near f_{min}. The frequency difference and the correction factor are calculated for a range of dip angles, and analytic approximations are given for use in computer programs. (auth)

27151 COSMIC RAY MUONS AT A DEPTH OF 754 hg/cm^2 IN THE KOLAR GOLD MINES. Krishnaswamy, M. R. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, S.; Ito, N.; Kawakami, S.; Miyake, S. Pramana; 5: No. 4, 211-226(Oct 1975).

A telescope of area 4 m^2, consisting of horizontal layers of plastic scintillators, neon flash tubes and absorbers, was operated at a depth of 754 hg/cm^2 in the Kolar Gold Mines. New values for the vertical intensities of muons have been obtained from observations of the angular distribution over the slant depths ~750-2300 hg/cm^2 and are compared with the existing measurements. From the angular distribution observed, it is concluded that muons are produced wholly through the decay of pions and kaons up to energies of the order of 1 TeV. A value of 0.3 ± 0.2 is estimated for the K/π ratio at production, for muon energies around 500 GeV. A decoherence distribution has been obtained for parallel muon events up to distances of the order of 10 m. From this we concluded that the average P_t of the parents of muons of energy ~250 GeV is of the order of 0.3 GeV/c. From an analysis of rock showers, we obtain the cross section for inelastic interaction of muons of mean energy 100 GeV as $(3.8 \pm 1.5) \times 10^{-30}$ cm^2/nucleon. (auth)

27152 ANTARCTIC SUBSTORM EVENTS OBSERVED BY SOUNDING ROCKETS, IONIZATION, OF THE D- AND E-REGIONS BY AURORAL ELECTRONS. Nagata, T.; Hirasawa, T.; Takizawa, M. (National Inst. of Polar Research, Itabashi, Japan). Planet. Space Sci.; 23: No. 9, 1321-1327(Sep 1975).

The ionization structure of the auroral arc was measured on a sounding rocket which penetrated into a bright auroral arc. The E-region electron density becomes large ($2 \sim 5 \times 10^5$ el/cm^3) only in the moving auroral arc, whose N_2^+ 4278 Å brightness is $1 \sim 2.5$ kR. The electron density in the D-region beneath the lower boundary of the arc (75 ~ 98 km in altitude) is also considerably enhanced to $2 \sim 5 \times 10^4$ el/cm^3. The present experimental results suggest a dual nature of the electron precipitation spectrum in the substorm, i.e. the softer part which is localized in the auroral arc and the harder part which is spatially wide-spread over the substorm area. (auth)

27153 SOLAR FLARE EFFECTS ON THE ZODIACAL LIGHT. Misconi, N. Y. Albany; State Univ. of New York (1975). 192p. University Microfilms Order No. 76-4611.

Thesis (Ph. D.).

An observational and theoretical study was carried out of possible solar flare effects on the zodiacal light. A total of 38 nights (February, March and April 1966, March 1967, and March 1968) of ground based observations, which were taken from Mt. Haleakala, Hawaii by Weinberg, were searched for solar flare effects. No changes were found in the shape of the main cone of the zodiacal light at elongations greater than 23 degrees from the sun to a limit of approximately 20 S_{10}(V) units, and none were found in the level of brightness from night to night to a limit of approximately 100 S_{10}(V) units. The earlier reported enhancement in the zodiacal light due to a large solar flare by Blackwell and Ingham (1961) is considered doubtful for two reasons: probable contamination of their observations by enhanced atmospheric emission, and detailed geometry of that event shows that is is unlikely that the plasma/dust interaction could have caused a 40 percent enhancement in the zodiacal light. Whether or not the plasma/dust interaction can be effective in causing a brightness change, a knowledge of the brightness contribution along the lines of sight and as a function of heliocentric distance is needed. For this purpose models of dielectric and metallic particles with spatial distribution of the form r/sup -nu/, nu equals 0,1,2, and size distribution of the form a/sup -p/, p equals 2.5,4, were computed using the Mie scattering theory. Dynamical processes affecting the dust particle's heliocentric orbit were considered in relation to brightness changes. (Diss. Abstr. Int., B)

27154 OPTIMUM PULSE REFLECTION FROM THE IONOSPHERE. El-Khamy, S. E. (Alexandria Univ., Egypt). Radio Sci.; 11: No. 1, 3-8(Jan 1976).

The synthesis of optimum signals for ionospheric reflection is treated. It is shown that these optimum signals, when incident on the ionosphere, result in reflected signals which are enhanced in magnitude and compressed in duration. The optimum band-limited signals are found to have relatively complicated frequency and amplitude modulations. The reflection of linearly swept carrier pulses having gaussian envelopes that approximate the optimum signals is also considered, with the result that considerable compression is seen to occur for these signals. The ionosphere is modeled as an inhomogeneous ionized medium with a linear ionization density profile and a constant collision frequency. (auth)

27155 DETERMINATION OF REPRESENTATIVE HEIGHT DISTRIBUTIONS OF THE ELECTRON CONCENTRATION IN THE IONOSPHERE. Dudeney, J. R. (British Antarctic Survey, Cambridge, Eng); Bradley, P. A. Radio Sci.; 11: No. 1, 9-11 (Jan 1976).

Median height distributions of electron concentration may be determined from ionograms by means of the composite ionogram technique of Wright, or by inserting tabulated parameters in the idealized model of Bradley and Dudeney. This paper discusses the complementary nature of these two approaches. (auth)

27156 SOME EFFECTS OF SOLAR ACTIVITY IN THE EARTH'S MIDDLE ATMOSPHERE. Frederick, J. E. Boulder, CO; Univ. of Colorado (1975). 263p. University Microfilms Order No. 76-3902.

Thesis (Ph. D.).

The role which solar activity plays in controlling minor neutral constituent concentrations in the earth's middle atmosphere (30-90 km) is investigated. The solar emissions whose time variations can influence chemical processes in the upper stratosphere and mesosphere are determined by analyzing the available knowledge on all forms of solar output. Those which are important for the present study are the ultraviolet electromagnetic spectrum (1100-3000A) and the energetic corpuscular flux, consisting primarily of protons, ejected from large solar flares. A method is described for computing atmospheric ionization and dissociation rates due to energetic proton bombardment. The particle impact dissociation of N_2 is of particular interest as it provides a source of atomic nitrogen in the high latitude middle atmosphere. The most significant effect associated with solar electromagnetic variations is the change in mesospheric ozone. This is due largely to hydrogen production by the action of Lyman alpha radiation on water vapor. The ozone concentration between 65 and 75 km can change by 25 percent during the course of a solar rotation. The chemistry initiated by nitrogen and hydrogen production in a solar proton event leads to the destruction of ozone in the middle atmosphere. The atomic nitrogen enhancement during solar proton bombardment leads to an increase in the nitric oxide density whose magnitude depends on the relative yield of ground and excited states resulting from N_2 dissociation. The excess NO produced in the upper stratosphere has a long chemical lifetime. Horizontal transport of this nitric oxide from the polar regions may influence the stratospheric ozone concentration on a global scale. (Diss. Abstr. Int., B)

Effects of Nuclear Detonations

27157 (AD/A-006574) REACTION RATE DATA. Number 48. Annual Summary of Progress in FY 1974 DNA Reaction Rate Program. (General Electric Co., Santa Barbara, Calif. (USA)). Sep 1974. Contract DNA001-74-C-0014. 26p. NTIS $3.75.

See also report dated Sep 1973, AD-771315.

Summaries of research on atmospheric reaction kinetics are presented. Topics concern upper atmosphere chemistry, atomic, molecular, and ionic reactions, and reactions related to nuclear fireball studies. (GRA)

Magnetospheric Phenomena

Refer also to abstracts 26958, 27098, 27099, 27100, 27101, 27110, 27111, 27119, 27131, 27134, and 27137.

27158 (ESRO-SP-107) EUROPEAN SOUNDING-ROCKET AND SCIENTIFIC-BALLOON ACTIVITY AT HIGH LATITUDES, WITH EMPHASIS ON THE INTERNAL MAGNETOSPHERIC STUDY (IMS), PROCEEDINGS OF A SYMPOSIUM HELD AT OERENAES SLOTT, SWEDEN, 9-12 SEPTEMBER 1974. Battrick, B. T.; Duc, N. T. (eds.). (European Space Research Organization, 92- Neuilly-sur-Seine (France)). 1974. 331p. (CONF-7409146-). ESRO Scientific and Technical Information Branch, Noordwijk, Netherlands.

Individual abstracts are provided for the thirty-nine presented papers. (BJG)

For abstracts of individual papers see: 26958, 26965, 27097–27111, and 27159–27180.

27159 (ESRO-SP-107, pp 5-6) FRENCH NATIONAL SOUNDING-ROCKET AND BALLOON PROGRAM RELATED TO THE IMS. Aubert, M. (CNES, Paris). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

Plans for the French sounding-rocket and balloon program during the IMS are discussed briefly. (auth)

27160 (ESRO-SP-107, pp 31-33) INTERNATIONAL MAGNETOSPHERIC STUDY 1976/78. Roederer, J. G. (Univ. of Denver). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27161 (ESRO-SP-107, pp 35-42) CURRENT PROGRAM OF THE "MOBILE RAKETENBASIS". Klein, R. (DFVLR, Oberfpaffenhofen, Ger.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27162 (ESRO-SP-107, pp 47-83) WAVES AND WAVE-PARTICLE INTERACTIONS IN THE MAGNETOSPHERE: A REVIEW. Gendrin, R. (CNET, Issey les Moulineaux, France). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

Recent space observations of waves, both electromagnetic and electrostatic, are reviewed and the role which they can play in the dynamics of magnetospheric particles is stressed. Wave-particle interactions (WPI) in the exo- and intra-plasmaspheric media depend on the exact process of particle injection under the influence of magnetospheric electric fields, and on the spatial distribution of the cold plasma particles; these two aspects of the problem are studied to some extent. The concepts of optimum cold plasma density, critical energy, limiting flux, marginal stability, steady-state equilibrium are critically discussed. The non-linear aspects—both experimental and theoretical—of WPI's are reviewed and a special section is devoted to active experiments in space. An attempt is made to outline which kind of experiments could be conducted at high-latitudes, in conjunction with IMS spacecraft, to arrive at a better understanding of magnetospheric processes involving waves and particles. (auth)

27163 (ESRO-SP-107, pp 85-102) PLASMAS OF THE MAGNETOSPHERE. Bryant, D. A. (SRC Appleton Lab., Slough, Eng.); Johnstone, A. D. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

The various plasmas that have been identified within the magnetosphere are recalled and presented within a topological framework which orders them in a fundamental way. The framework used for the magnetosphere and its bounding plasmas has six different regions. They are the solar wind, the magnetotail, the plasmasphere, the plasma sheet, the distant tail, and the ionosphere. (auth)

27164 (ESRO-SP-107, pp 103-123) PLASMA CLOUDS AND AURORAL ARCS. DeForest, S.; Judge, R. (Univ. of California, San Diego). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

Suggestions are offered for correlative measurements associated with the GEOS synchronous satellite on the basis of measurements by ATS-5 and ATS-6 and on recently developed techniques for presenting ground-based observations. 40 references (auth)

27165 (ESRO-SP-107, pp 125-140) STUDIES OF MAGNETIC SUBSTORMS USING GROUND-BASED, BALLOON, ROCKET AND SATELLITE OBSERVATIONS. Rostoker, G. (Univ. of Alberta, Edmonton). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

During the last few years, the increasing wealth of correlative data has led to a rapidly increasing understanding of the physics of the magnetospheric substorm process. However, because of the relatively small scale size of substorn disturbed regions, the existing measurements have always to be interpreted with the realization that it is generally not known what the location of the detectors was with respect to the region of maximum perturbation. The International Magnetospheric Study (IMS) will attempt to rectify this problem by encouraging co-operation among magnetospheric physicists so as to maximize the amount of supporting data available for any particular observing campaign. This paper will deal with the present understanding of the configuration of particles and fields in the region of the auroral oval, and will point out the conflicts and disagreements which surround some of these concepts. The strengths and weaknesses of the various methods of monitoring substorm activity will be discussed, and some suggestions will be made as to ways of resolving the existing misunderstandings in the field of substorm morphology in the light of anticipated research activity during the IMS. 60 references (auth)

27166 (ESRO-SP-107, pp 143-148) SITUATION REPORT ON GEOS. Knott, K. (ESTEC, Noordwijk, Netherlands). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27167 (ESRO-SP-107, pp 149-157) GEOS FIELD AND WAVE EXPERIMENTS. Pedersen, A. (ESTEC, Noordwijk, Netherlands). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

A broad outline of the satellite observation program foreseen by the scientific groups associated with the field and wave experiments on GEOS is given. Technical details of the experiments will only be given in so far as they are important for the understanding of the scientific observations; emphasis will be on explaining the type of data to be obtained, the sensitivities to various magnetospheric parameters, and the resolutions in the time and frequency domains. The relations between satellite observations of fields and waves on the one hand and rocket, balloon and ground observations on the other will also be discussed. (auth)

27168 (ESRO-SP-107, pp 159-165) GEOS PARTICLE EXPERIMENTS. Wrenn, G. L. (UCL Mullard Space Science Lab., Surrey, Eng.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity

at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

The four particle experiments aboard the European geostationary magnetospheric satellite GEOS which will be launched in 1976 as the reference spacecraft for the International Magnetospheric Study are described. Those characteristics of the instruments are emphasized which relate to the co-ordinated aspects of the mission and to the use of the particle data together with the GEOS wave and field measurement and associated GBR observations. (auth)

27169 (ESRO-SP-107, pp 167-174) OUTLINE AND PROGRESS OF THE INTERNATIONAL SUN–EARTH EXPLORER PROJECT. Durney, A. C. (ESTEC, Noordwijk, Netherlands). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

The most interesting features for this mission study will be the bow shock and the magnetosheath. The intention is to investigate wave-particle interactions in these regions. The dayside geometry of both the bow shock and the magnetosphere is well described by gas dynamics, but their internal structure and mechanisms have not been measured and are not understood. In each case past results have been obscured by motions and instabilities on these surfaces induced by changes in the upstream medium. Another important study area will be the detailed mechanisms of substorms. For example, one of the tandem spacecraft in the tail and the other nearer the earth or at the high-latitude magnetopause would be a suitable configuration to discover how energy is transferred from the solar wind into the tail during the growth phase. (auth)

27170 (ESRO-SP-107, pp 175-180) DATA HANDLING DURING THE IMS. Lenhart, K. G. (ESOC, Darmstadt, Ger.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

During the International Magnetospheric Study (IMS) a large number of research programs are planned. One prime aim is to achieve a well co-ordinated analysis of the data collected to further our understanding of the processes taking place in the magnetosphere. The data produced will vary widely in type, embracing both ground-based measurements and measurements carried out in space (Fig. 1). To provide a basis for efficient and quick correlation of data from various research groups and projects, it is essential that sufficient information be made available to all participants. For this reason, several co-ordinating bodies will monitor the handling and collection of appropriate data. The aims of the Satellite Situation Center (SSC), and the data handling for the GEOS satellite, which is to be the reference spacecraft during IMS, are described. (auth)

27171 (ESRO-SP-107, pp 181-186) AURORAL-ZONE X-RAY MEASUREMENTS WITH BALLOON-BORNE INSTRUMENTS AS A PART OF THE GEOS PROJECT. Kremser, G. (Univ., Graz). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

The importance of auroral-zone x-ray measurements with balloon-borne instruments during the GEOS project is discussed. Emphasis is given to special investigations using simultaneous x-ray measurements and particle and field data from a geostationary satellite. Problems involved in balloon programs during the GEOS mission are also discussed. (auth)

27172 (ESRO-SP-107, pp 195-200) PROPOSAL FOR A NEW TYPE OF ION TRACER EXPERIMENT USING AN ION MASS SPECTROMETER AT THE GEOSTATIONARY ORBIT. Young, D. T. (Univ. of Bern). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

A new concept in ion tracer experiments in the magnetosphere is proposed. Barium or lithium ions injected at the foot of the 6.6 R_E field line by conventional shaped-charge release might be detectable in the equatorial plane by a mass-energy spectrometer of the type to be flown on the GEOS satellite. Comparison of optical and mass-spectrometric detection techniques shows the latter to be more sensitive in some cases by several orders of magnitude. An analysis shows Coulomb collisions to be insufficient for scattering the necessary fraction of beam ions into the pitch-angle viewing range of the detector. The GEOS spectrometer is shown to be sensitive enough to detect isotropic tracer ion densities of $10^{-4} \sim 10^{-6}$ cm^{-3}, depending on ion species and energy. (auth)

27173 (ESRO-SP-107, pp 201-204) SOUNDING-ROCKET EXPERIMENTS FOR DETAILED STUDIES OF MAGNETOSPHERIC SUBSTORM PHENOMENA. Stuedemann, W.; Wilhelm, K. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27174 (ESRO-SP-107, pp 217-220) PROPOSED RELEASE EXPERIMENT TO STUDY IONOSPHERIC-MAGNETOSPHERIC COUPLING. Holmgren, G. (Uppsala Ionospheric Observatory). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27175 (ESRO-SP-107, pp 261-266) ENERGY AND ANGULAR DISTRIBUTION OF AURORAL PARTICLES RESULTING FROM TIME-VARYING ACCELERATION. Hall, D. S.; Bryant, D. A. (SRC Appleton Lab., Slough, Eng.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

It is generally accepted that the "magnetic-field-aligned" charged particles, that occur in some forms of auroral precipitation, have been collimated by an acceleration parallel to the geomagnetic field lines, within a few thousand kilometers of the earth's surface. Static electric fields parallel to the magnetic field lines have frequently been invoked to account for this acceleration. The consequences of such a static electric field are examined. (auth)

27176 (ESRO-SP-107, pp 279-294) "AIRES" CONTROLLED SOUNDING ROCKET. Arritt, R. D. (Naval Research Lab., Washington, DC); Dugan, C. S. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27177 (ESRO-SP-107, pp 301-305) DFVLR ACTIVITIES FOR THE IMS–AIRES PROJECT. Bader, H. (DFVLR, Oberpfaffenhofen, Ger.). 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27178 (ESRO-SP-107, pp 307-308) CO-ORDINATION OF ROCKET CAMPAIGNS DURING IMS. Stockfleth Jorgensen, T.; Fahleson, U. 1974.

From symposium on European sounding-rocket and scientific-

balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27179 (ESRO-SP-107, pp 311-312) CO-ORDINATION OF OBSERVATIONS RELATED TO GEOS AND IMS ROCKET CAMPAIGNS. Rycroft, M. J. (Univ. of Southampton, Eng.); Wrenn, G. L. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27180 (ESRO-SP-107, pp 313-314) RESOLUTIONS ADOPTED BY THE SYMPOSIUM ON THE CO-ORDINATION OF OBSERVATIONS RELATED TO GEOS AND IMS ROCKET CAMPAIGNS. 1974.

From symposium on European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the international magnetospheric study; Oerenaes Slott, Sweden (9 Sep 1974).

In European sounding-rocket and scientific-balloon activity at high latitudes, with emphasis on the Internal Magnetospheric Study (IMS). (European Space Research Organization, 92- Neuilly-sur-Seine (France)).

27181 THE MODEL DEPENDENCE OF DIFFERENTIAL POWER SPECTRA OF INCOHERENT CERENKOV RADIATION. Noda, A. (Geophysical Institute, University of Tokyo, Tokyo, Japan); Tamao, T. J. Geophys. Res. 81: No. 1, 287-290 (1 Jan 1976).

On the basis of the consideration that incoherent Cerenkov radiation from precipitating electrons with energy of less than 1 keV is nearly electrostatic, the emission process for high-latitude VLF hiss is reexamined semiquantitatively. It is pointed out that a peak intensity of the spectral power for the guided Cerenkov emission occurs near the local electron plasma frequency at a point along the field line where the plasma frequency coincides with the local electron cyclotron frequency. This result gives us a reasonable explanation for the main difference between the two previous studies of (1) Jørgensen and (2) Lim and Laaspere. (auth)

27182 LOCAL TIME DEPENDENCE OF THE LOSS OF ENERGETIC ELECTRONS FROM THE SLOT REGION OF THE RADIATION BELTS. Imhof, W.L.; Gaines, E.E.; Reagan, J.B. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). J. Geophys. Res. 81: No. 1, 291-293 (1 Jan 1976)

An investigation has been made of the local time morphology of electron (>130 keV) precipitation from the slot region of the radiation belts. Quasi-trapped electrons ($h_{min}<0$) were observed just east of the South Atlantic anomaly at low altitudes (~ 800 km) from the satellite 1971-089A. On the average, the fluxes of electrons precipitating in the daytime are greater than those near midnight, consistent with the findings of Vampola et al. In addition, shortly after 0800 hours MLT there is a pronounced increase in the frequency of occurrence of peaks in the energy spectra. These peaks have central energies that decrease rapidly with increasing L value. The data reveal that the electron loss processes are more effective during the daytime than near midnight and that there may be basic differences in the nature of the precipitation mechanisms at the two times. (auth)

27183 REPEATED SHARP FLUX DROPOUTS OBSERVED AT 6.6 R_E DURING A GEOMAGNETIC STORM. Su, S. (Planetary and Earth Sciences Department, Lockheed Electronics Company, Houston, Texas 77058); Fritz, T.A.; Konradi, A. J. Geophys. Res. 81: No. 1, 245-252 (1 Jan 1976).

A number of repeated rapid flux dropouts have been observed at 6.6 R_E by the NOAA low-energy proton detectors on board the ATS 6 satellite during the July 4–6, 1974, geomagnetic storm period. These rapid flux changes are caused by the fact that the outer boundary of the trapped radiation region moves back and forth past the satellite. Although a tilting field line configuration can cause the boundary to pass the satellite, as has frequently been reported in the literature, the boundary is shown to be distorted by a large surface wave traveling eastward around the earth. The maximum velocity of the wave was observed to be $\simeq 40$ km/s. (auth)

27184 OBSERVATIONS OF MAGNETOSPHERIC IONIZATION ENHANCEMENTS USING UPPER HYBRID RESONANCE NOISE BAND DATA FROM THE RAE 1 SATELLITE. Mosier, S.R. (Radio Astronomy Branch, Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 81: No. 1, 253-256 (1 Jan 1976).

Noise bands associated with the upper hybrid resonance have been used to provide direct evidence for the existence of regions of enhanced density in the equatorial magnetosphere near $L=2$. Density enhancements ranging from several percent to as high as 45% are observed with radial dimensions of several hundred kilometers. The enhancement characteristics strongly suggest their identification as magnetospheric whistler ducts. (auth)

27185 THE UPPER- AND LOWER-FREQUENCY CUTOFFS OF MAGNETOSPHERICALLY REFLECTED WHISTLERS. Edgar, B.C. (The Aerospace Corporation, Laboratory Operations, Los Angeles, California 90009). J. Geophys. Res. 81: No. 1, 205-211 (1 Jan 1976).

The upper-frequency cutoffs of magnetospherically reflected (MR) whistlers observed by the Ogo 1 and 3 satellites are explained in terms of trapping of the upper-frequency components above the cutoff by sharp density gradients across L shells. The lower-frequency cutoffs are interpreted in terms of waveguide attenuation and D region absorption of the atmospheric source energy and defocusing of the MR whistler energy in the magnetosphere. (auth)

27186 NEUTRAL SHEET OBSERVATIONS AT 1000 R_E. Villante, U. (Istituto Fisico, University of L'Aquila, L'Aquila, Italy). J. Geophys. Res. 81: No. 1, 212-215 (1 Jan 1976).

A detailed analysis of magnetic field observations internal to the field reversal regions suggests the presence, at ~ 1000 R_E (Pioneer 7), of a well-defined neutral sheet still preserving most of its near-earth characteristics. The normal direction to the rotation plane of the magnetic field vector is consistent with an aberrated tail model. Observed large values of the reconnection component, occasionally southward, at the reversal point might be interpreted in terms of closed loops of opposite field lines. Order of magnitude estimates of the sheet dimensions confirm a sheet thickness of 0.1–1 R_E. (auth)

27187 STORM-ASSOCIATED VARIATIONS OF EQUATORIALLY MIRRORING RING CURRENT PROTONS, 1–800 keV, AT CONSTANT FIRST ADIABATIC INVARIANT. Lyons, L.R.; Williams, D.J. (Space Environment Laboratory, NOAA, ERL, Boulder, Colorado 80302). J. Geophys. Res. 81: No. 1, 216-220 (1 Jan 1976).

Explorer 45 observations of ring current protons mirroring near the equator, 1–800 keV, are presented at constant first adiabatic invariant μ throughout the period of the December 17, 1971, geomagnetic storm. To obtain μ, we have used simultaneous magnetic field and particle observations. Particle deceleration in response to the storm time magnetic field decrease causes ring current measurements viewed at constant energy to underestimate the storm time increase in proton intensities at energies $\lesssim 200$ keV. This adiabatic deceleration also accounts for the large flux decreases observed at energies $\gtrsim 200$ keV during the storm, in contradiction with previous results (Söraas and Davis, 1968) obtained using a model for the storm time magnetic field. (auth)

27188 PROTON FLOW MEASUREMENTS IN THE MAGNETOTAIL PLASMA SHEET MADE WITH IMP 6. Hones, E.W. Jr.; Bame, S.J.; Asbridge, J.R. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Geophys. Res. 81: No. 1, 227-234 (1 Jan 1976).

Patterns of proton flow in the magnetotail plasma sheet are described. They are derived from observed anisotropies of the flux of protons measured with the Los Alamos Scientific Laboratory (LASL) plasma probe on Imp 6. These observations, made in the geocentric distance range $r\simeq 25$–32 R_E, are entirely consistent with those made at $r\simeq 18$ R_E with Vela satellites and reported earlier. In particular, the substorm thinning and thickening of the plasma sheet are seen and are accompanied by antisunward, then sunward, flow of plasma as they are at the Vela orbit. During one substorm the Goddard Space Flight Center magnetometer on the satellite clearly showed the Z component of the magnetic field in the plasma sheet to be southward throughout the expansion phase, while antisunward flow prevailed, and then to become suddenly northward again as the flow turned sunward at the substorm's recovery. This observation of the magnetic field behavior provides important confirmation of the view, regarding neutral line formation and movement during substorms, that has been established earlier on the basis of plasma flow measurements made by the Vela satellites. A dawn-to-dusk cross-tail proton flow comprising a proton current of $\sim 10^7$ protons/cm^2 $-s(\sim 1.6\times 10^{-12}$ A/cm^2) was observed as the magnetometer indicated that the satellite was crossing the magnetic 'neutral sheet.' This observation further supports our earlier suggestion that dawn-to-dusk cross-tail proton flows, measured occasionally with the Vela satellites, constituted the magnetotail neutral sheet current. On one occasion, sunward flow of plasma at ~ 300–1000 km/s was observed to persist for ~ 9 hours in the plasma sheet concurrent with nearly continuous magnetic activity in the auroral zone. The interplanetary magnetic field (IMF) was quite intense and inclined steeply southward for 8 hours prior to, and throughout most of, this 9-hour interval. It appears that the magnetosphere responded to this occurrence of very prolonged strong southward IMF not with repeated substorms but by establishment of continuous rapid earthward convection of plasma from some region of the tail beyond $r\simeq 27$ R_E. The plasma convection and

magnetic activity died away gradually during a period of ~2 hours after the IMF suddenly became northward. (auth)

27189 SOLAR-INDUCED 5- TO 6-YEAR CYCLES OF GEOMAGNETIC ACTIVITY AND THEIR PREDICTION. Kuksenko, V. I.; Mikhailovskii, V. N. Otbor Peredacha Inf.; No. 42, 3-5 (1974). (In Russian).

The present work demonstrates the existence of 5- to 6-year cycles in the variation of mean annual values for the integral characteristics of planetary tidal forces on the solar surface and in the cophasal variations of the mean annual values for geomagnetic activity during the years 1944 to 1972. Data on the number of proton and all chromospheric flares on the sun and on the intensity of solar radio emission at 200 MHz from 1954 to 1964 are also shown to be correlated. (IAA)

27190 PITCH-ANGLE DIFFUSION OF RING CURRENT PROTONS CAUSED BY ELECTROSTATIC ION LOSS-CONE WAVES. Roennmark, K. (Umeaa Univ., Sweden). Planet. Space Sci.; 23: No. 9, 1337-1339(Sep 1975).

Pitch-angle diffusion of ring current protons is investigated, assuming that the scattering is caused by resonant interaction with electrostatic ion loss-cone waves. Bounce averaged diffusion coefficients are presented for different wave energy distributions. It is found that wave amplitudes about 1 mV/m are required to give strong diffusion of protons with average energy. (auth)

27191 SATELLITE STUDY OF THE HIGH ENERGY PROTON ENVIRONMENT UNDER THE RADIATION BELT. Dhingra, K. C. Albuquerque, NM; Univ. of New Mexico (1975). 114p. University Microfilms Order No. 75-28,683.

Thesis (Ph. D.).

Proton data outside of the South Atlantic Radiation anomaly (in the regions where h/sub min/ less than or equal to 0) from the University of New Mexico High Energy Neutron and Proton Detector aboard OSO-6 satellite were analyzed. The detector was useful in the energy range from 75 to 145 MeV and the data were obtained during the period from August 1969 to January 1971. The altitude of the satellite varied from about 480 Km to 580 Km. (Diss. Abstr. Int., B)

27192 ENTRY OF LOW-ENERGY SOLAR PROTONS INTO THE EARTH'S MAGNETOTAIL. Saflekos, N. A. Iowa City, IA; Univ. of Iowa (1975). 90p. University Microfilms Order No. 76-2172.

Thesis (Ph. D.).

Simultaneous observations of sudden changes in solar proton intensities by one spacecraft outside and by one or two spacecraft inside the earth's magnetotail are reported here. In a number of cases of triple satellite observations one spacecraft is in the north and the other in the south lobe of the tail. Associated with the sudden intensity changes are magnetohydrodynamic discontinuities in the solar wind. Like sharp boundaries the discontinuity surfaces confine protons of energy E/sub p/ greater than 0.3 MeV to one of their sides as they are convected outward from the sun with the solar wind speed. Tail length calculations included in this work show that the effective tail length increases as the position of the interior satellite recedes from the magnetopause, regardless of the direction of the interplanetary magnetic field. Generally the downstream distances of direct entry into the magnetotail are between 25 and 900 R/sub E/. Sharp intensity discontinuities and even fine structures in the low-energy solar proton profiles in the solar wind are preserved and detected with a time delay in the magnetotail. No smoothing out of the structures is observed which is considered as evidence against diffusive access of low-energy protons to the geomagnetotail lines. The cross sectional radii rho of the magnetospheric tail at two different cuts through it at different distances X from the earth along the sun-earth line (rho approximately equal to 14.6 R/sub E/ at X equals -4.5 R/sub E/ and rho approximately equal to 20.9 R/sub E/ at X equals -24.4 R/sub E/) were determined to an accuracy of one earth radius using particle means only. For an assumed polar cap scale length of 3500 km and the observed time delays, values of field line convection velocity at low altitudes and high latitudes are estimated. (Diss. Abstr. Int., B)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

27193 (JUL-1204) ELECTRONIC ENERGY LOSS OF FAST MOLECULES IN MATTER. Steinbeck, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (F. R. Germany)). Jun 1975. 124p. (In German). INIS.

In high velocity collisions of molecular ions the correlated motion influence of the ion cores on the electronic energy loss is investigated. The stopping power in first Born approximation for a random arrangement of target atoms can be formulated in terms of the inelastic electronic structure factor. In treating the target atoms in Hartree-Fock approximation each electron can be regarded as stopping the ion independent of all other electrons without restriction by the Pauli principle. A second equivalent formulation of the stopping power leads to the dielectric function of the target. The results are applied to the stopping of H_2^+ ions. For vanishing distance between the two protons the stopping power per particle is twice that for single proton collisions. For distances in the order of the Bohr radius the correlated stopping power may even be smaller than for uncorrelated protons. With increasing distances the correlation influence vanishes. The stopping of H_2^+ ions in C, Si and Ge is discussed using Clementi wave functions for the core electrons and a free electron approximation with Lindhard's dielectric function for the valence electrons. The comparison with the only experimental result available for H_2^+ in C at 300 keV yields qualitative agreement. (DE)

27194 (LBL-3399(Suppl.)) PROCEEDINGS OF THE SECOND SYMPOSIUM ON ION SOURCES AND FORMATION OF ION BEAMS, BERKELEY, CALIFORNIA, 22-25 OCTOBER 1974. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1974. 402p. (CONF-741019-). Dep. NTIS $12.00.

Topics covered include: ion source discharges; extraction and formation of beams; new types of ion sources; negative ion sources I-polarized ion sources; heavy ion sources; high-current multiple-aperture ion sources; applications of ion sources in science and technology; negative ion sources II; and a supplement of 4 papers. Of the 13 invited papers and 61 contributed papers, abstracts of 9 have appeared previously in NSA; and abstracts of 53 appear separately in this issue of NSA and ERA. (GHT)

For abstracts of individual papers see: 25574, 25609–25615, 25639, 25674–25686, 26931–26947, 27195–27207, and 27248.

27195 (LBL-3399(Suppl.), pp I.1.1-I.1.12) OSCILLATIONS IN ION-SOURCE DISCHARGES AND THEIR RELATION TO ION BEAM PROPERTIES. Lejeune, C. (Institut d'Electronique Fondamentale, Orsay, France). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Strong fluctuations are commonly observed in discharge-ion sources. They are correlated to the deterioration of the source properties such as power and gas efficiency, and beam transport and focus. The improvement of source performance requires a reduction of the fluctuation level. Therefore it is necessary to get more insight in the mechanisms which may drive instabilities and to find the conditions either for their stabilization or elimination. These two aspects of the problem of stability are considered in the case of the main instabilities which affect the different parts of a discharge: the circuit, the sheaths, and the plasma. In the case of the plasma, microinstabilities and macroinstabilities are examined separately, as most usual source discharges appear to be magnetohydrodynamically unstable. The experimental results concerning the effects of instabilities on source properties are summarized. 90 references. (auth)

27196 (LBL-3399(Suppl.), pp I.6.1-I.6.5) STUDY OF THE OSCILLATIONS IN REFLEX-ARC ION SOURCE PLASMA AND ITS INFLUENCE ON EXTRACTED BEAM TRANSVERSAL DISPERSEDNESS. Kulygin, V. M. (I. V. Kurchatov Inst. of Atomic Energy, Moscow). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Ion source reflex-arc plasma oscillations are investigated. It is found that frequencies of most intensive oscillations in discharge plasma take place in the range from 50 kc to 1 Mc. These oscillations are caused by rotating disturbances and may be divided into two kinds. The first kind of oscillations take place if neutral hydrogen pressure in the discharge chamber is relatively small. According to its main characteristics these oscillations can be identified as a drift-dissipative instability, modified by rotation in crossed electric and magnetic fields. The second kind of oscillations takes place when charged particle-neutral collision frequencies become quite big. The most probable reason for these oscillations is instability, rising from difference between ion and electron "friction" against a neutral gas. The main working pressure range where ion beam was extracted was that where the first kind of oscillations took place. In this work an influence of these oscillations on ion beam transversal dispersedness is studied. Measurements demonstrate increasing of beam dispersedness when discharge oscillations amplitude is increased. (auth)

27197 (LBL-3399(Suppl.), pp I.9.1-I.9.6) SELF-CROSSED FIELD ION SOURCES. Takagi, T. (Kyoto Univ.); Yamada, I.; Kunori, M.; Kobiyama, S. 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

To obtain an intense ion beam from various kinds of materials, a new PIG type ion source without external magnetic field has been designed and operating characteristics have been studied. In an ordinary type of ion source, voltages are applied to electrodes such as the anode, filament, and extractor under the crossed magnetic field. If a spiral filament or anode is used and heavy DC current flows through the electrode keeping the potential relationship between the filament, anode, and extractor electrodes constant, a magnetic field due to the heavy current can be used effectively for the ionization of materials. Since the magnetic field produced by the electrode system is crossed with an electric field, a new PIG type ion source is obtained which may be called a self-crossed field ion source. Basically, two types of the self-crossed field ion source are proposed. One is the outer filament coil type in which the crossed field is constructed from filament current; the other is an outer helical anode type constructed from spiral anode current. Since the self-crossed ion source has a simple and compact structure without an external magnetic coil, the source is suitable to operate under high temperature and to introduce microwave or RF power. To get an intense ion beam, these ion source units can operate in parallel. Therefore, many new application fields can be expected. (auth)

27198 (LBL-3399(Suppl.), pp II.10.1-II.10.4) FORMATION OF INTENSE ION BEAM WITH A MULTIPLE-SLOT EXTRACTOR. Kulygin, V. M. (I. V. Kurchatov Inst. of Atomic Energy, Moscow); Panassenkov, A. A.; Semashko, N. N.; Boldasov, V. S.; Volkov, B. I.; Sveshnikov, A. G. 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Computer calculations for the design of a slotted extractor for a source of intense beams of hydrogen ions are described. The ion trajectories from the source are determined by the program. The resulting extractor design was tested, and results of the tests are presented. (GHT)

27199 (LBL-3399(Suppl.), pp III.2.1-III.2.6) BEAM-PLASMA TYPE ION SOURCE FOR HIGH-INTENSITY ION BEAM. Takagi, T.; Yamada, I.; Ishikawa, J.; Sano, F.; Kusano, N. (Kyoto Univ.). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

In a beam-plasma type ion source, the gas is effectively ionized by the microwave power (2 to 20 GHz) transferred from an electron beam through beam-plasma interactions, which are the interactions between the magnetically focused electron beam injection from the ion extractor and the plasma in the drift tube. A high-density and stable plasma is obtained in the drift tube by this beam-plasma discharge because of the microwave heating ionization and the feedback phenomenon which keeps the plasma density constant. When ions are extracted from the high-density

plasma produced in the drift tube, they are accelerated in the opposite direction of the electron beam by the same electric field that accelerates the electron beam, and the space charge of the ion beam is highly neutralized by the injected electron beam near the ion extractor. Therefore, a high-intensity and well-confined ion beam is obtained. Moreover, although the extracted ion current increases, the emittance of the ion beam is kept low because of ions trapped in the negative-potential well induced by the electron beam near the ion extractor. (auth)

27200 (LBL-3399(Suppl.), pp VI.4.1-VI.4.5) ION SOURCES WITH LOW VOLTAGE EXTRACTION USING GLOW DISCHARGE. Kiyama, H. (Ministry of International Trade and Industry, Tokyo). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Experimental results are given for a new type of plasma source and for the beam efficiency of a multi-aperture three-electrode extraction system at energy 500 to 1000 eV. This plasma source consists of a thin grid in front of a cathode and of a large cylindrical anode mounted close to the extraction electrode. High density, highly ionized, large uniform plasma is produced by glow discharge even with low discharge current. The plasma diameter (2 to 4 cm in diameter) is controlled by the position of line cusp field near the cathode. The densities of hydrogen plasma and argon plasma are more than $10^{12}/cm^3$ and more than $10^{13}/cm^3$, respectively. The temperatures of the plasmas are about 2 to 3 x 10^4 °K. This source is operated steady state at 0.5 A with ion energy of 0.5 to 1 keV. The multi-aperture electrodes are of copper 0.5 mm thick and 4 cm in diameter. 400 apertures are made by the photo-etching method. The extraction electrode is recessed. The ratio r/d of the radius of extraction aperture to the distance between the positive and negative electrode is varied. At an optimum ratio r/d the electrical efficiency is about 90 percent and the divergence of the beam is 5° in low ion beam current (about 150 mA). But in higher ion beam current (about 250 mA) the efficiency decreases. (auth)

27201 (LBL-3399(Suppl.), pp VII.1.1-VII.1.8) ION BEAMS AND MATERIAL TECHNOLOGY. Rose, P. H. (Extrion Corp., Gloucester, MA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The types of ion beams required for material technology such as analysis of surfaces and implantation of semiconductors are identified. Improvement in brightness, without sacrifice of total current, would have a strong effect on the economics of application of ion beams in the lower current ranges. For a large scale process such as the production of corrosion resistant steel sheet, ampere currents of heavy ions are needed. Sources of this type have not yet been constructed although they are possible in principal. (auth)

27202 (LBL-3399(Suppl.), pp VII.4.1-VII.4.6) VAPOURIZED METAL CLUSTER ION SOURCE FOR HIGH INTENSITY ION BEAM APPLICATIONS. Takagi, T. (Kyoto Univ.); Yamada, I.; Kunori, M.; Kobiyama, S. 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A new type of ion source with intense equivalent current has been developed. In the source, an ionized vapor aggregate (cluster) is used instead of atomic or molecular ions in ordinary ion sources. A cluster consisting of 10^2 to 10^3 atoms is formed by adiabatic expansion due to the ejection into a high vacuum region through the nozzle of a heated crucible. The clusters are ionized by electron bombardment and accelerated toward a target. The fundamental considerations on the formation and the ionization of clusters have been studied. Applications of cluster ions in industry, such as film formation, are described and fundamental effects of the formation of deposited films have been analyzed. (auth)

27203 (LBL-3399(Suppl.), pp VII.6.1-VII.6.5) SMALL DIAMETER NEGATIVE ION PROBE. Purser, K. H.; Hanley, P. R.; Liebert, R. B. (General Ionex Corp., Ipswich, MA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A small diameter ion probe has been designed for use in surface analysis systems. The probe uses a duoplasmatron with a fixed offset to produce a negative oxygen beam. The source is bakeable, featuring gold and ceramic-to-metal seals. A dual electrostatic lens system and velocity filter focuses the beam to a spot smaller than 30 mu m and a prototype has produced an output current of one microampere of O^- in less than 100 mu m diameter. The system has independently adjustable extraction and beam energies and the beam spot size is adjustable. (auth)

27204 (LBL-3399(Suppl.), pp VII.7.1-VII.7.5) HOLLOW CATHODE DUOPLASMATRON FOR REACTIVE GAS IONS. Roden, H. J. (Applied Research Labs., Goleta, CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A duoplasmatron using a hollow cathode rather than a heated cathode has been developed for a series of instruments. These instruments use a primary ion beam to bombard a sample and create secondary ions that are subsequently mass analyzed. The composition of an unknown sample can then be determined by the mass spectra produced by such an instrument. Some of the requirements of an ion source for this application are (1) high brightness at less than 20 keV, (2) low energy spread to reduce the chromatic aberration of the primary beam, (3) low gas flow rates so that differential pumping may be avoided, and (4) the ability to generate positive and negative ions from reactive gases. (auth)

27205 (LBL-3399(Suppl.), pp VII.8.1-VII.8.4) VERSATILE ION SOURCE MANIFOLD AND RAPID ION BEAM INTERCHANGE. Wilson, R. G. (Hughes Research Labs., Malibu, CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Experimental results of rapid switching among ion species in an ion source and high voltage beam system are reported. Times of 1.5 to 6 min were required to switch from full beam current of any one of several ions to any other one of the ions with essentially no waiting for equilibration and little interference from ion species in each new ion beam resulting from prior operation. The ion source manifold used to achieve these results is described. The ions B^+, P^+, As^+, and S^+ were selected for the experiment to be representatively difficult. The total beam currents were about 0.5 mA. (auth)

27206 (LBL-3399(Suppl.), pp VIII.1.1-VIII.1.6) SURFACE: PLASMA SOURCE OF NEGATIVE IONS. Belchenko, Yu. I.; Dimov, G. I.; Dudnikov, V. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A powerful source of negative ions with the gas discharge chamber of planotron geometry is described which gives an H^- beam with the current density in the emission slit up to 3.7 A/cm^2 due to intense secondary negative ion emission from the cathode surface, bombarded by the fast discharge particles. The emitted ion beam intensity is nearly proportional to the emission slit surface. The source with the emission slit of 0.9 x 30 mm^2 yields a negative ion beam of 0.88 A with accompanying electron load not more than 1.7 A. (auth)

27207 (LBL-3399(Suppl.), pp VIII.8.1-VIII.8.6) CONTACT IONIZATION NEGATIVE ION SOURCE. Zuccaro, D. E.; Dulgeroff, C. R. (Hughes Research Labs., Malibu, CA). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of ion beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

A high brightness contact ionization source of negative iodine ions has been developed for use in an ion beam microprobe mass analyzer. The contact ionization process was selected instead of the conventional electron attachment technique because of the small ion energy spread, the low gas load, and the high efficiency of the contact source. The source is a planar LaB_6 cathode which is mounted in a modified Pierce ion optics geometry. A molecular beam of iodine vapor is directed toward the cathode surface. The

negative ions and electrons emitted from the surface are accelerated and focused into a narrow beam. A transverse electromagnetic field is used to separate the ion and electron fractions. Ion current densities of 5 to 10 mA/cm^2 were generated at cathode temperatures of 1650 to 1775^{0}K. The electron-to-ion ratios were on the order of 100 to 300. Ionization efficiencies of 5 to 45 percent were observed in this temperature range. The ion source was operated at a brightness level estimated to be 100 A/cm^2-sr at 10 kV. (auth)

27208 DETERMINATION OF ENERGY SPECTRA OF BACKSCATTERED ELECTRONS BY USE OF EVERHART'S THEORY. McAfee, W.S. (US Army Electronics Command, Fort Monmouth, New Jersey 07703). J. Appl. Phys. 47: No. 3, 1179-1184 (Mar 1976).

Everhart's theory on the backscatter of electrons from solids is extended so as to yield the backscatter coefficient as a function of the retarding potential rejecting backscattered electrons having energies below a certain fraction of the energy of the primaries. From this function an analytical expression is obtained for the energy spectra of backscattered electrons with the atomic number of the target material as a parameter. Limited comparisons with experiments are included. The theory is found to give reasonable agreement with electron backscatter experiments for primary electron energies above about 1 keV and target materials having atomic numbers up to about 40. The upper energy limit of perhaps 100 keV is set by the relative importance of bremsstrahlung and relativistic effects which are not included in the Thomson-Whiddington law. Theoretical energy spectra display observed behavior of measured spectra under variation of the atomic number of the target. Energy spectra obtained from this theory give results which are in rather good agreement with experiment for backscattered electrons having energies in the range of about 0.25 to 0.90 of the energy of primary electrons. (auth)

27209 MAGNETIC FIELD EFFECTS ON THE EMISSION LAW OF ELECTRON CURRENT FROM CATHODES. Goldstein, S.A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). J. Appl. Phys. 47: No. 3, 894-896 (Mar 1976).

The Child-Langmuir emission law is corrected to include magnetic field effects. The treatment is performed in local Cartesian coordinates near the cathode surface and all the terms obtained include first-order relativistic effects. The effect of space charge flowing back to the cathode is also considered. The importance of using the corrected emission laws in the simulation of relativistic diodes is discussed. (auth)

27210 CALIBRATION OF AN INSTRUMENT FOR DETECTING HYDROGEN ATOMS WITH ENERGIES 0.2–8 keV. Kislyakov, A.I.; Stöckel, J.; Jakubka, K. (Institute of Plasma Physics, Academy of Sciences of the Czechoslovakian SSR, Prague). Sov. Phys.–Tech. Phys. 20: No. 7, 986-987 (July 1975).

Measurements of the secondary emission yields for negative particles (electrons and negative ions) are reported for the incidence of hydrogen atoms and ions with energies 0.2–8 keV on contaminated Cu, CuBe, Mo, and Al surfaces. The emitter material does not significantly affect the secondary emission yields. (auth)

27211 CONDITIONS FOR THE SELF-DESTRUCTION OF A PULSED INTENSE RELATIVISTIC ELECTRON BEAM. Friedman, M.; Siambis, J.G. (Naval Research Laboratory, Washington, D. C. 20375); Bacon, D.P. Appl. Phys. Lett. 28: No. 6, 308-311 (15 Mar 1976).

It has been found that the stable flow of a magnetically focused unneutralized intense relativistic electron beam (IREB) depends on beam front parameters (e.g., current and voltage rise times) and on the geometry of the propagation region (e.g., length). It is argued in this letter that a pulsed IREB is susceptible to a two-stream instability resulting from reflection of electrons from the beam front. This effect may have to be taken into account in IREB applications involving fast rise times and/or long drift lengths, such as ion accelerators, electron autoaccelerators, and intense microwave generators. (auth)

27212 STRESS-INDUCED EFFECTS IN SPUTTERING AND SURFACE ANALYSIS. Dearnaley, G. (AERE, Harwell, Oxfordshire, United Kindom). Appl. Phys. Lett. 28: No. 5, 244-245 (1 Mar 1976).

The compressive stress gradients induced by relatively energetic ion bombardment in sputtering, for surface analysis and cleaning, are shown to result in the possibility of atom migration and compositional changes. A solution to these problems is proposed. (auth)

27213 SURFACE IONIZATION NEGATIVE ION SOURCE. Rachidi, I.; Monte, J.; Pelletier, J.; Pomot, C.; Rinchet, F. (Laboratoire de Physique des Plasmas, Equipe de Recherche Associée au CNRS, Université Scientifique et Médicale, Grenoble I, France). Appl. Phys. Lett. 28: No. 5, 292-294 (1 Mar 1976).

A negative ion source that utilizes a porous lanthanum hexaboride surface to generate iodine ions is described. Iodine vapor supplied to the back of the lanthanum hexaboride ionizer from a reservoir percolates through to the front surface where the iodine is evaporated as ions. The peak ion current obtained—2.1 mA at an ion energy of 0.3 keV—leads to a density $n \simeq 10^{10}$ cm^{-3}. (auth)

27214 FORMING A BEAM OF ACCELERATED MULTICHARGED IONS FOR MAKING RADIOBIOLOGICAL EXPERIMENTS AND ITS DOSIMETRY AND MONITORING. Kudryashov, E. I.; Marennyi, A. M.; Popov, V. I. pp 59-63 of Voprosy mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124.

The installations used at the UMZI-300 cyclotron to obtain multicharged ion beams for radiobiological experiments are briefly described and the beam characteristics are discussed and tabulated. The ion beams considered are ^{12}C, ^{10}B, ^{20}Ne, and ^{40}Ar. Dose determinations were made with ionization chambers, Faraday cups, or emission chambers. (JSR)

27215 LIMITATION OF THE CURRENT OF A FAST ELECTRON BEAM BY THE SPACE-CHARGE FIELD IN A DIELECTRIC. Evdokimov, O. B.; Kononov, B. A.; Yagushkin, N. I. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9: 139-141(1975). (In Russian).

Experimental data are available on the interaction of fast electrons with holes created during irradiation of a dielectric, with thickness greater than the mean free path. The possibility of limiting the beam current when the thickness is less than the mean free path was studied experimentally using polymethylmethacrylate, polystyrene, polyethylene, fluoroplast, and NaCl and KCl crystals. An analysis of the experimental data obtained with 1.05-MeV electrons indicates that changes in the current on the electrode is caused by space-charge limitation of the current. (JSR)

27216 BEAM-FOIL-EXCITED AUGER TRANSITIONS IN NEON. Groeneveld, K. O.; Mann, R.; Nolte, G.; Schumann, S.; Spohr, R. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik); Fricke, B. (Gesamthochschule Kassel (F. R. Germany). Theoretische Physik). Z. Phys., A; 274: No. 3, 191-194(1975).

2 figs.; 1 tab.; 10 refs.

Energy spectra of electrons ejected from collisions between a carbon foil and Ne projectiles with energies between 1.4 and 20 MeV have been measured. Continuous and discrete electron energy distributions are observed. Auger transitions of foil-excited Ne have been studied. Using relativistic Dirac-Fock multiconfiguration calculations, most of the measured Auger transitions have been identified. (DE)

27217 GENERATION AND CONTAINMENT OF MULTIPLY CHARGED IONS IN A RF QUADRUPOLE ION TRAP. Schwebel, C.; Moeller, P. A.; Pham Tu Manh (Paris-11 Univ., 91–Orsay (France). Inst. d'Electronique Fondamentale). Rev. Phys. Appl.; 10: No. 4, 227-239(Jul 1975). (In French)

It is shown that production and storage of multiply charged ions are possible with a three-dimensional RF quadrupole ion trap. The theoretical basis for the trapping of charged particles is first briefly examined and the dependence of ionization on the phase of the RF field is examined in order to derive the optimum operating modes for the creation of highly charged ions. The second part of the paper is devoted to the description of the experimental apparatus, and results are reported, showing for the first time the storage and detection of multiply charged ions with such a system. (FR)

27218 SIMULATION OF ELECTRON BACK-SCATTERING BY A MONTE-CARLO METHOD. Gruzin, P. L.; Rodin, A. M. Sov. At. Energy (Engl. Transl.); 38: No. 4, 326-328(Apr 1975).

Translated from At. Energ.; 38: No. 4, 256-258(Apr 1975).

Differential and integral characteristics were calculated by a Monte-Carlo method for back-scattering of electrons with an energy E_0 = 200 keV from semi-infinite aluminum and uranium targets for normal incidence and information was also obtained about the statistics of motion within the target for electrons emerging in the backward direction. The calculations were based on a "discrete energy loss" model which, in contrast to the "continuous loss" approximation makes it possible to include fluctuations in electron energy losses from the relations of Landau theory. In addition, the use of this model provides an opportunity to reduce the consumption of machine time significantly. (1 table, 3 figures) (auth)

27219 MEASUREMENTS OF X-RAY ATOMIC SCATTERING FACTORS OF HIGH-Z METALS. Tirsell, K. G.; Slivinsky, V. W.; Ebert, P. J. (Univ. of California, Livermore). Phys. Rev., A; 12: No. 6, 2426-2437(Dec 1975).

The coherent scattering of 25- to 75-keV filtered fluorescence K alpha radiation from thin Sn, Sm, Ta, Pt, and Au foils has been measured absolutely. Values of atomic scattering factors in the

range of q equals sin(theta/2)/lambda from 0.5 to 5.5 A^{-1} were obtained for five different incident energies with scattering angles ranging from 45 to 135°. The results are compared with Cromer's recent relativistic Dirac-Slater calculations with and without anomalous dispersion corrections. When plotted against the ratio of the target K-edge energy to the incident energy, differences between measured and calculated scattering factors follow the same general trend for all these high-Z elements. Before they are corrected for dispersion, the calculated scattering factors for incident energies below the target K-absorption edge exceed the measured values, with the difference increasing in magnitude as the K edge is approached. After the dispersion correction, the calculated values are all lower than the measured values by about 1.3 units. For incident energies above target K edges, differences are generally small; but uncorrected calculated scattering factors also exceed the experimental values in a rapidly increasing manner as the K edge is approached. After they are corrected for dispersion, calculated values are lower than measured values by about 0.6 units. Improved agreement can be obtained over the whole energy range for each element by arbitrarily reducing the magnitude of the real part of the dispersion correction term to that of the principal anomalous term. (auth)

Atomic and Molecular Properties

Refer also to abstracts 26823, 27258, 27286, and 27294.

27220 (DESY-SR-75/09) $N_{4,5}$ EXCITATIONS IN METALLIC CESIUM: SINGLE ELECTRON BEHAVIOR AND COLLECTIVE EFFECTS. Petersen, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jul 1975. 13p. INIS.

6 figs.; 1 tab.; 50 refs.

The $N_{4,5}$ excitation spectrum of Cs was measured with yield spectroscopy from the onset of transitions at 77 eV to 180 eV photon energy. Synchrotron radiation served as a light source. A broad maximum due to delayed transitions to f-symmetric continuum states is the dominating feature of the spectrum. An indication for existence of localized f-symmetric final states is found. Above the $N_{4,5}$ edges at 77.1 ± 0.1 eV and 79.3 ± 0.1 eV photon energy transitions to p-symmetric extended metal states are observed. Their qualitative agreement with APW band structure calculations is discussed. EDC's obtained with photon energies of 75 and 111 eV are presented. The observed asymmetric shape of the 4d photoemission maxima in the EDC's and the shape of the N_5 edge are discussed with regard to the final state interaction theory by Mahan, Nozieres and de Dominicis. (DE)

27221 INTRACOLLISIONAL INTERFERENCE IN THE SPECTRUM OF HD MIXED WITH RARE GASES. Poll, J.D. (Department of Physics, University of Nijmegen, Nijmegen, The Netherlands); Tipping, R.H.; Prasad, R.D.G.; Reddy, S.P. Phys. Rev. Lett. 36: No. 5, 248-251 (2 Feb 1976).

We present the first observation and interpretation of an interference effect in the infrared absorption spectrum of HD-rare-gas mixtures. This effect, due to constructive or destructive interference between allowed and collision-induced dipoles during a collision, is referred to as "intracollisional interference." It is manifested by the appearance of a narrow line at the $R_1(1)$ position which increases with rare-gas density. This interference has relevance to the determination of HD abundance in planetary atmospheres. (auth)

27222 THE EFFECT OF SHAPE FACTOR ON THE QUANTAL COLLISION INTEGRALS. Dutta, S.; Rakshit, A.B. (Department of General Physics and X Rays, Indian Association for the Cultivation of Science, Calcutta 700032, India). J. Chem. Phys. 64: No. 4, 1337-1339 (15 Feb 1976).

Quantal collision integrals taking into account the shape factor which represents a nonspherical repulsive part of molecular interactions have been evaluated by using the tabulations of collision integrals for the Lennard-Jones (12:6) potential. The angular part of the interactions has been averaged by assuming that the colliding particles maintain the same relative orientation during an encounter and that all relative orientations have equal probability. The results show that the shape factor has significant influence on the quantal collision integrals. Attempts have been made to interpret the viscosity and thermal diffusion factor data for H_2 and D_2 gases. Another important result of these calculations is that, contrary to earlier assumptions, it is necessary to consider the effect of shape factor on viscosity for the precise determination of quadrupole moment of these substances from second virial and viscosity data. (auth)

27223 NEW FORMULA TO ESTIMATE THE GROUND STATE ENERGY, E_0. Thomas, G.F.; Javor, F.; Rothstein, S.M. (Department of Chemistry, Brock University, St. Catharines, Ontario, Canada L2S 3A1). J. Chem. Phys. 64: No. 4, 1574-1579 (15 Feb 1976).

The one-electron reduced local energy function, $E_L(1)$, is introduced which has the properties $\langle E_L \rangle = \langle H \rangle$, and $\langle E^2{}_L \rangle \leqslant \langle H^2 \rangle$. It is suggested that the accuracy of E_L reflects the local accuracy of an approximate wavefunction. From the properties of E_L a modified form of Weinstein's formula, E_w', is defined which is bounded as follows: $E_w \leqslant E_w' \leqslant \langle H \rangle$, where E_w is Weinstein's lower bound formula for the ground state energy, E_0. The estimate to E_0 provided by E_w' is not guaranteed as an upper or lower bound, but it provides a useful adjunct to $\langle H \rangle$ which does not require $\langle H^2 \rangle$. Applications to a variety of approximate wavefunctions for $X\,^1\Sigma^+_g$ H_2 and $1\,^1S$ He are presented. (auth)

27224 POLARIZABILITY AND DIELECTRIC PROPERTIES OF HELIUM. Kirouac, S.; Bose, T.K. (Département de physique, Université du Québec, Trois-Rivières, Québec, Canada). J. Chem. Phys. 64: No. 4, 1580-1582 (15 Feb 1976).

A precise measurement of the dielectric second virial coefficient of helium gives a value which compares very favorably with the previously determined experimental value of Orcutt and Cole. The dielectric third virial coefficient agrees reasonably well with the calculation of Heller and Gelbart based on the Hartree–Fock theory. (auth)

27225 A FORBIDDEN SINGLET–TRIPLET ANTICROSSING IN D_2. Miller, T.A.; Freund, R.S.; Zegarski, B.R. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 64: No. 4, 1842-1847 (15 Feb 1976).

Anticrossings have been observed between the $v=4$, $N=2$, G $(3d)\,^1\Sigma_g$ and $v=0$, $N=2$, r $(4d)\,^3\Pi_g$ states of D_2. These anticrossings fall into two distinct sets, fairly weak and quite narrow (<15 G) anticrossings induced by spin–orbit coupling and stronger and broader (~ 100 G) anticrossings introduced by the Fermi contact hyperfine interaction. Analysis of the positions of the anticrossings has allowed an accurate determination of the levels' zero field separation, the g factors of both the singlet and the triplet, and the quadratic Zeeman parameters for both the singlet and triplet. Hyperfine structure is also observed in four of the anticrossings which provides a measure of the diagonal Fermi contact interaction in the $^3\Pi$ state. The widths of the anticrossing curves provide values for the spin–orbit and the Fermi contact perturbations between the two states. (auth)

27226 STARK EFFECT IN A HYDROGEN ATOM SUBJECTED TO A STRONG RESONANT WAVE. Fedorov, M.V. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 11, 1323-1325 (Nov 1975).

An analysis is made of the Stark effect in a hydrogen atom subjected to a static electric field and the field of a strong resonant electromagnetic wave. It is shown that the resonant interaction modifies the linear (with respect to the static field intensity) splitting of the atomic levels and gives rise to a quadratic shift of sublevels. (auth)

27227 INELASTIC TRANSITION FORM FACTORS IN THE H ATOM. Barut, A.O. (Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302); Wilson, R. Phys. Rev. A 13: No. 3, 918-926 (Mar 1976).

Arbitrary inelastic transition form factors in the H atom have been exactly evaluated in closed form by a group-theoretical method. The final expression contains exactly known $O(4)$ and $O(2,1)$ representation function and a single trivial finite sum. We also give the square of the form factors summed over l and l' and obtain as a special case the result of Massey and Mohr. (auth)

27228 GLAUBER CROSS SECTIONS FOR INNER-SHELL IONIZATION IN MULTIELECTRON TARGETS BY ELECTRON IMPACT. Golden, J.E.; McGuire, J.H. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 13: No. 3, 1012-1017 (Mar 1976).

Total cross sections for K-shell ionization of the ground state of multielectron targets by electron impact have been computed using the single-particle Glauber approximation. Various hydrogenic product wave functions are used to describe both the bound and continuum electron. Projectile-target electron exchange effects are simply approximated by limiting the region of integration over ejected electron momenta so as to avoid double counting. Using this exchange approximation and choosing reasonable effective charges initially and finally for the target, agreement is obtained with existing helium data at projectile energies above 100 eV. The effects of changing various parameters are shown and discussed, and comparisons are made with Born approximations. For $Z > 3$ differences between our Glauber and Born total cross sections are small. (auth)

27229 GENERAL PROPERTIES OF PARAMETRIC RESONANCE AND ITS INVESTIGATION IN THE CASE OF THE $^2P_{\frac{1}{2}}$ STATE OF ^{23}Na. Dohnalik, T.; Kucal, H.; Lubowiecka, T. (Jagellonian Univ., Krakow). Acta Phys. Pol., Ser. A49: No. 1, 81-91(Jan 1976).

The properties of parametric resonance were calculated in the general case of atom with hfs for intermediate magnetic fields. The results of these calculations were confirmed by an experiment performed for the excited state $^2P_{\frac{1}{2}}$ of ^{23}Na. This agreement suggests several new possibilities of applications of the parametric resonance in the atomic spectroscopy. (auth)

27230 HYPERFINE STRUCTURE MEASUREMENTS IN THE $^4I_{\frac{9}{2}}$ GROUND STATE OF ^{141}Pr. Boeklen, K. D.; Bossert, T.; Foerster, W.; Fuchs, H. H.; Nachtsheim, G. (Bonn Univ. (F. R. Germany). Inst. fuer Angewandte Physik). Z. Phys., A; 274: No. 3, 195-201(1975).

3 figs.; 5 tabs.; 24 refs.

Using the atomic beam magnetic resonance method, the five hyperfine structure separations in the $4f^3\,6s^2{}^4J_{\frac{9}{2}}$ ground state of ^{141}Pr have been measured. From these quantities, the multipole interaction constants A_k, k = 1, 2, 3, 4 between the nucleus and the electron shell have been calculated. A_4 especially then served to give the following limit for the intrinsic hexadecapole moment: $/Q_{40}/ < 0.4\ eb^2$. Furthermore, the g_J- factors of the ^4J multiplet have been measured at magnetic fields of 300 Oe. Small corrections due to perturbations by neighboring fine structure levels are included. (DE)

27231 COORDINATE ASYMPTOTICS OF TWO-ELECTRON WAVE FUNCTION IN THE COULOMB FIELD. Sochilin, G. B.; Yur'ev, M. S. Teor. Mat. Fiz.; 25: No. 3, 410-413(Dec 1975). (In Russian)

Asymptotics of the Coulomb two-electron wave function belonging to the continuous spectrum is studied, with the electron interaction taken into account. An explicit form for the zeroth coefficient in the expansion of the wave function in the asymptotical series over the powers of the parameter R ($R = \sqrt{r_1^2 + r_2^2}$) is found. A physical interpretation of the expression obtained is given. It is pointed out that the small value of the cross section of the double photoionization of helium atom can be explained by the presence of the node surface in the final state wave function. (auth)

27232 ORIENTATIONAL ORDERING IN MOLECULAR HYDROGEN. I. Transition Temperature and Changing of Symmetry. Tareeva, E. E.; Trapezina, T. I. (Inst. of Physics of High Pressure, Moscow). Teor. Mat. Fiz.; 26: No. 2, 269-276 (Feb 1976). (In Russian)

Orientational ordering in rigid cubic orthohydrogen and paradeuterium is described in terms of bifurcation points of the solution of nonlinear integral equation obtained in the mean field approximation. For one of admissible transitions the critical temperature and the angular dependence of the correlation function are in a good agreement with experimental data.

27233 VARIATION OF THE ELECTROSTATIC INTERACTION OF $4f^2$ ELECTRONS UNDER PRESSURE. Voloshin, V. A.; Kulagin, N. A.; Ovander, L. N.; Prudnikov, A. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 39: No. 3, 334(Sep 1975).

Translated from Opt. Spektrosk.; 39: No. 3, 599-600(Sep 1975).

The specimen was subjected to pressure of 25 kbar at or near the temperature of liquid nitrogen in a barocryostat. The results of the spectral investigation are given. The parameters obtained with these data are given. (auth)

27234 FIVE-PHOTON IONIZATION OF HELIUM. Mostowski, J. (Polish Academy of Sciences, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 6, 713-715(1975).

A new interpretation of the Bakos et al. experiments on the five-photon resonant ionization of helium is given. (auth)

27235 PARITY NONCONSERVATION IN TRANSITIONS BETWEEN HYPERFINE STRUCTURE COMPONENTS OF HEAVY ATOMS. Novikov, V. N.; Khriplovich, I. B. (Nuclear Physics Inst., Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 22: No. 3, 74-76(5 Aug 1975).

Translated from Pis'ma Zh. Eksp. Teor. Fiz.; 22: No. 3, 162-165(5 Aug 1975).

The circular polarization of the radiation in transitions between the hyperfine structure (hfs) components of heavy atoms is calculated. A possible experiment wherein this effect can be observed is indicated. (auth)

27236 RELATIVISTIC HARTREE–FOCK–ROOTHAAN THEORY FOR OPEN-SHELL ATOMS. Kagawa, T. (Nara Women's Univ., Japan). Phys. Rev., A; 12: No. 6, 2245-2256(Dec 1975).

The expansion method for the nonrelativistic Hartree–Fock theory by Roothaan is extended to relativistic cases for general open-shell atoms. Numerical applications of the theory to the first transition elements are carried out. It is shown that the conventional approximation of the exchange potential shifts the energy value considerably, whereas the off-diagonal Lagrange multiplier has little effect on the energy. Some problems in the application of the theory to open-shell atoms are discussed. (auth)

27237 PROLATE-SPHEROIDAL ORBITALS FOR HOMONUCLEAR AND HETERONUCLEAR DIATOMIC MOLECULES. III. Shielding Effects for the Many-Electron Problem. Aubert, M. (Institut National des Sciences Appliquees de Lyon, Villeurbanne, France); Bessis, N.; Bessis, G. Phys. Rev., A; 12: No. 6, 2298-2311(Dec 1975).

The determination of shielded diatomic orbitals (SDO's) which are eigenfunctions in prolate-spheroidal coordinates, of the two-center problem with an effective (cylindrically symmetric) parametric potential, is extended to many-electron systems. The simultaneous iterative resolution of the separated equations is significantly improved by the consideration of a simple electrostatic model and of the connection with a Mathieu equation. Calculations are carried out for three- and four-electron diatomic systems, i.e., HeH, LiH^+, He_2^+, LiH, and He_2 in their ground states. From our results, the SDO's appear to be comparable to the self-consistent field orbitals. They should be also a good basis set for "diabatic" molecular states. Possibility of an extension, without supplementary difficulties, of the effective potential is investigated. (auth)

27238 DIVERSE MANIFESTATIONS OF BARRIERS TO ATOMIC ELECTRONS. Fano, U. (Univ. of Chicago). Phys. Rev., A; 12: No. 6, 2638-2640(Dec 1975).

Attention is called to phenomena that should serve as sensitive indicators of the field acting upon slow electrons as they traverse the edge of atoms. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 27283 and 27402.

27239 MUONIUM CHEMISTRY IN GASES: $Mu + Br_2$. Fleming, D.G.; Brewer, J.H.; Garner, D.M. (TRIUMF and Department of Chemistry, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5); Pifer, A.E.; Bowen, T.; Delise, D.A.; Crowe, K.M. J. Chem. Phys. 64: No. 4, 1281-1287 (15 Feb 1976).

We report a precise measurement of the rate of reaction of muonium atoms with bromine molecules in an argon moderator gas at 1 atm and 23 °C. The bimolecular rate constant is $k = (2.4 \pm 0.3) \times 10^{11}$ l/mole-sec, ten times higher than that for the analogous reaction of hydrogen atoms. Since muonium can properly be treated as a light isotope of hydrogen, this comparison has potential significance for the theory of reaction rates. The technique is described and the results discussed. (auth)

27240 MUON CAPTURE BY DEUTERON. Dogotar, G. E.; Salganik, Yu. A.; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 3, 472-478(Sep 1975). (In Russian).

Absorption of muons by deuterons is considered. The following properties are investigated: velocity of the capture, the energy spectrum and asymmetry of angular distribution for neutrons. Results of the calculations are presented for three cases of the initial state of the muonic atom: doublet state, quartet state and in case of the statistical level population. (auth)

27241 POLARIZATION OF THE ANNIHILATION PHOTONS OF TRIPLET POSITRONIUM. Faraci, G.; Pennisi, A. R. (Univ., Catania, Italy). Nuovo Cim.; 31B: No. 2, 288-296(11 Feb 1976).

The linear-polarization distribution of the annihilation photons of triplet positronium in S-state and perform the analysis of experimental results which can be obtained by Compton scattering. Possible deviations from the quantum-mechanical approach are discussed. (auth)

27242 ATOMIC CAPTURE OF NEGATIVE MESONS IN HYDROGEN. Korenman, G. Ya.; Rogovaya, S. I. (Moscow State Univ.). Yad. Fiz.; 22: No. 4, 754-762(Oct 1975). (In Russian)

An approximate method of summing up over the final states of the mesoatom, based on the properties of hydrogen-like wave functions in the momentum representation, is presented to calculate the total cross sections for atomic capture of negative mesons. Analytical formulae are obtained for the capture cross sections in the Born approximation with plane waves and orthogonalized plane waves. Concurrence of the deceleration processes and of the atomic capture of negative muons in hydrogen is considered. As follows from the calculations, the meson energy before the capture is, as a rule, essentially more than the hydrogen ionization potential. 2 figures. (auth)

27243 ORTHO-PARACONVERSION OF POSITRONIUM IN A DIELECTRIC WITH METALLIC INCLUSIONS. Gol'danskii, B. I.; Levin, B. M.; Shantarovich, V. N.; Agievskii, D. A.; Landau, M. V.; Tatur, A. O.; Shishkin, A. V. (Inst. of Chemical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 22: No. 4, 97-98 (20 Aug 1975).

Translated from ZhETF Pis. Red.; 22: No. 4, 211-214(20 Aug 1975).

A new mechanism was experimentally established for the ortho-paraconversion of positronium localized in a dielectric matrix near the surface of a metallic particle. (auth)

27244 EFFECT OF ELECTRIC FIELD ON POSITRONIUM PRODUCTION IN LIQUIDS. Anisimov, O. A.; Raitsimring, A. M.; Molin, Yu. N. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 22: No. 4, 91-92(20 Aug 1975).

Translated from ZhETF Pis. Red.; 22: No. 4, 197-199(20 Aug 1975).

A decrease is observed in the probability of production of a positronium atom in nonpolar liquids under the influence of external electric fields. An explanation is offered within the framework of the track model of positronium production. (auth)

27245 KAONIC AND OTHER EXOTIC ATOMS. Seki, R. (California State Univ., Northridge); Wigand, C. E. Annu. Rev. Nucl. Sci.; 25: 241-281(1975).

Topics covered in this review include: basic characteristics of exotic atoms; experimental findings of x-ray intensities of kaonic, sigmonic, and antiprotonic atoms; level shifts and widths; particle properties derived from exotic atoms, including mass, magnetic moment, and polarizability; atomic phenomena directly related to nuclear properties, such as nuclear quadrupole moment and dynamical quadrupole mixing; products from nuclear absorption of K^-, SIGMA$^-$, and anti p. Theoretical information presented includes: atomic capture and cascade; K^--nucleus optical potential; anti p- and SIGMA$^-$-nucleus optical potential; and two- and one-nucleon absorption products. 9 figures, 6 tables, 134 references. (GHT)

Collision Phenomena

Refer also to abstracts 25497, 27228, 27777, and 27803.

27246 (AD/A-007055) TABLES OF SCATTERING AMPLITUDES, SPIN POLARIZATIONS AND PHASE SHIFTS OF 25-eV TO 1500-eV ELECTRONS SCATTERED ELASTICALLY FROM Li, Na, Mg, P, K, Ca, Sc, Mn, Ga, Br, Sr, Mo, Rh, Cd, Ba, W, AND Os. III. Technical Report. Gregory, D. C.; Fink, M. (Texas Univ., Austin (USA). Electronics Research Center). 15 Aug 1974. Contract F44620-71-C-0091. 284p. NTIS $8.75.

See also AD-734282.

The Dirac equation was solved numerically by the method of partial waves in order to obtain elastic low-energy electron scattering factors for selected elements at ten energies. From the complex scattering amplitudes, the differential cross sections and spin polarization factors were calculated. In addition, the phase shifts for these elements at five more energies have been included. Since the exchange of the incoming electron with the atomic electrons and the charge cloud polarization are not taken into account in these calculations, the scattering factors at angles of less than 10 degrees should be used with caution. The three reports in this series can be used as a basis for interpolation to obtain the differential cross sections for all additional elements and all intermediate energies. (GRA)

27247 (AD/A-008510) VIBRATIONAL DEACTIVATION OF HF(v = 1) AND DF(v = 1) BY H AND D ATOMS. Interim Report. Heidner, R. F. III; Bott, J. F. (Aerospace Corp., El Segundo, Calif. (USA)). 31 Mar 1975. Contract F04701-74-C-0075. 37p. NTIS $3.75.

The deactivation of HF(v = 1) and DF(v = 1) by H and D atoms was studied at 295 K by means of the techniques of laser-induced infrared fluoresence and isothermal calorimetry. The upper limits for the deduced rate coefficients are well-defined, but the lower limits are imprecise. The results of this study are compared with other experimental data and with trajectory calculations. Qualitative data are presented regarding the role of reactive, i.e., F-atom exchange, versus nonreactive collisions in the removal of the v = 1 level. A verification of the method was made by determining a rate coefficient for H + HCl(v = 1) that is in good agreement with a recent study. (GRA)

27248 (LBL-3399(Suppl.), pp II.11.1-II.11.3) INVESTIGATION OF A GAS CELL PLASMA, GENERATED BY CHARGE EXCHANGE OF INTENSE ION BEAM. Kulygin, V. M.; Panassenkov, A. A. (I. V. Kurchatov Inst. of Atomic Energy, Moscow). 1974.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In proceedings of the second symposium on ion sources and formation of iron beams. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

The parameters of a secondary plasma, generated in a gas cell by charge exchange of a hydrogen ion beam, extracted from a plasma source, are investigated. Measurements show that secondary plasma parameters change considerably along the gas cell. Near the source, the plasma density is about $5 \cdot 10^{12}$ cm^{-3}, electron temperature is about 1 eV, and plasma potential is about 4 V. Toward the end of the cell plasma density decreases considerably, electron temperature increases to 7 + 8 eV, and plasma potential increases to 60 V. (auth)

27249 SURFACE AND VACUUM PHYSICS INDEX. Volume 11, No. 1, 1976. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 67p.

27250 SURFACE AND VACUUM PHYSICS INDEX. Volume 10, No. 11, 1975. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 61p.

27251 SURFACE AND VACUUM PHYSICS INDEX. Volume 10, No. 12, 1975. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 50p.

27252 ABSOLUTE CROSS SECTIONS FOR SINGLE AND MULTIPLE ELECTRON-IMPACT IONIZATION OF He, Ne, AND Ar. Shchemelinin, S.G.; Andreev, E.P. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR). Sov. Phys.—Tech. Phys. 20: No. 7, 941-943 (July 1975).

The absolute cross sections for the production of ions in various states have been measured for impact ionization of He, Ne, and Ar by 4.1-keV electrons. The total ionization cross section for neon is found as a function of the energy over the electron energy range 4–14 keV. Factors tending to distort accurate measurement of the cross sections for multiple ionization are analyzed. The results disagree with those reported by van der Wiel *et al.* but agree with data reported by Schram. (auth)

27253 ELASTIC SCATTERING OF MEDIUM-ENERGY ELECTRONS BY METAL FILMS. Bronshtein, I.M.; Pronin, V.P. (A.I. Gertsen Pedagogical Institute, Leningrad). Sov. Phys.—Solid State 17: No. 8, 1610-1610 (Aug 1975).

Angular distributions are reported for the elastic scattering of 0.1–2 keV electrons from films of Be, Al, Cu, Ag, and Au. (AIP)

27254 PERIODIC ANISOTROPY FLUCTUATIONS IN QUASIMOLECULAR X—RAY EMISSION. Wölfli, W.; Stoller, C.; Bonani, G.; Stöckli, M.; Suter, M. (Laboratorium für Kernphysik, Eidgenössische Technische Hoschschule, 8049 Zürich, Switzerland); Däppen, W. Phys. Rev. Lett. 36: No. 6, 309-312 (9 Feb 1976).

We have found striking periodic intensity fluctuations in the anisotropy of noncharacteristic x-ray radiation emitted in Ca-Ca, Fe-Fe, and Ni-Ni collisions. It is shown that the properties of this new effect can be interpreted as quasimolecular transitions in a rotating two-center system. (auth)

27255 NEGATIVE ION FORMATION IN HALOCARBONS BY CHARGE EXCHANGE WITH CESIUM. Tang, S.Y.; Mathur, B.P.; Rothe, E.W. (Research Institute for Engineering Sciences and Department of Chemical Engineering, Wayne State University, Detroit, Michigan 48202); Reck, G.P. J. Chem. Phys. 64: No. 4, 1270-1275 (15 Feb 1976).

A crossed molecular beam apparatus is used to study the formation of anions by charge exchange of fast cesium atoms with a variety of halocarbons. The branching ratios are determined from threshold to 350 eV. Comparison of the spectator stripping and information theoretical models to the data leads to the conclusion that this class of reactions is an example of an ultradirect impulsive mechanism. In the most favorable case, that of CF_3I, we have determined the near threshold relative cross sections for the anions CF_3I^-, I^-, CF_3^-, and IF^-. From these we determine the electron affinity of CF_3I^- to be 1.4±0.2 eV and the bond dissociation energy of CF_3-I^- as 0.38±0.1 eV, which disagrees with values obtained in a previous experiment. (auth)

27256 ELECTRON IMPACT INVESTIGATION OF ELECTRONIC EXCITATIONS IN FURAN, THIOPHENE, AND PYRROLE. Flicker, W.M.; Mosher, O.A.; Kuppermann, A. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). J. Chem. Phys. 64: No. 4, 1315-1321 (15 Feb 1976).

The electronically excited states of furan, thiophene, and pyrrole have been studied by electron impact at scattering angles from 0° to 80°, and impact energies of 30 and 50 eV. Low-lying features at 3.99 and 5.22

eV in furan, 3.75 and 4.62 eV in thiophene, and 4.21 eV in pyrrole are identified as singlet → triplet transitions. The locations and, for furan and thiophene, the energy splittings of these excitations suggest that they are analogous to the lowest $\pi \rightarrow \pi^*$ singlet → triplet transitions in benzene, and that these heterocycles have appreciable aromatic character. A weak feature observed in pyrrole at 5.22 eV is attributed to an optically forbidden singlet → singlet transition. In all three molecules, transitions to several superexcited states are observed. (auth)

27257 ABSOLUTE ELASTIC DIFFERENTIAL ELECTRON SCATTERING CROSS SECTIONS IN THE INTERMEDIATE ENERGY REGION. II.—N_2. Srivastava, S.K.; Chutjian, A.; Trajmar, S. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Chem. Phys. 64: No. 4, 1340-1344 (15 Feb 1976).

Utilizing a recently developed method, the ratios of elastic differential cross sections (DCS) of N_2 to those of He have been measured at electron impact energies of 5, 7, 10, 15, 20, 30, 40, 50, 60 and 75 eV covering an angular range of 20° to 135° at each energy. The absolute values of N_2 DCS (which, in the present work, also include the DCS for pure rotational excitation) have been obtained from these ratios by the use of absolute He DCS of McConkey and Preston. From the differential cross sections, elastic integral and momentum transfer cross sections have been evaluated. The results of the present experiment are compared with some previous measurements. (auth)

27258 ATTRACTIVE WELL OF He–He FROM ^{3}He–^{4}He DIFFERENTIAL ELASTIC SCATTERING MEASUREMENTS. Burgmans, A.L.J.; Farrar, J.M.; Lee, Y.T. (Department of Chemistry and The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 64: No. 4, 1345-1350 (15 Feb 1976).

The elastic differential cross section for ^{3}He–^{4}He was measured at a relative collision energy of 0.799×10^{-14} erg, approximately five times the well depth. The data are fitted to a multiparameter potential form with $\epsilon/k=10.57$ °K and $r_m=2.97$ Å. Comparisons with recent experimental and theoretical helium potentials are made. No evidence for a significant isotope effect in the ^{3}He–^{4}He and ^{4}He–^{4}He interatomic potentials is found in this work. (auth)

27259 SCATTERING OF HIGH-VELOCITY Ar ATOMS BY CO_2, OCS, AND CS_2. Amdur, I.; Peters, W.A.; Jordan, J.E. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Mason, E.A. J. Chem. Phys. 64: No. 4, 1538-1540 (15 Feb 1976).

Fast Ar beams have been scattered by room-temperature CO_2, OCS, and CS_2 to obtain average atom–molecule potentials. The results are consistent with other scattering measurements on similar systems, and are also in excellent agreement with available theoretical calculations based on an electron–gas model. Decomposition of the atom–molecule potentials into constituent atom–atom potentials shows that such a representation can be utilized with fair accuracy but that a definite discrepancy exists. (auth)

27260 PIECEWISE ANALYTIC WAVEFUNCTIONS FOR BOUND STATES AND SCATTERING. Rosenthal, A.; Gordon, R.G. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). J. Chem. Phys. 64: No. 4, 1621-1629 (15 Feb 1976).

Methods presented previously [J. Chem. Phys. 51, 14 (1969); Methods Comput. Phys. 10, 81 (1971)] for constructing piecewise analytic (Airy function) solutions to the close-coupled equations of molecular scattering and bound states are reviewed and developed further. The original formalism is rederived using Green's function techniques. The first order perturbation integrals are rewritten in a more compact and numerically stable form. A quadrature is presented for integrating products of wavefunctions of unequal diagonal slopes. Numerically efficient techniques are presented for constructing single channel bound state functions and using them in matrix element and overlap integrals. (auth)

27261 COORDINATE SYSTEMS FOR COLINEAR INELASTIC AND REACTIVE SCATTERING DEFINED BY CONFORMAL TRANSFORMATION. Rosenthal, A.; Gordon, R.G. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). J. Chem. Phys. 64: No. 4, 1630-1640 (15 Feb 1976).

In order to build wavefunctions for colinear reactive scattering from solutions of a one-dimensional Schrödinger equation, it is necessary to change the coordinate system from mass-weighted Jacobi coordinates (x,y) to a system of reaction coordinates that retains the ∇^2 character of the kinetic energy operator. Connor and Marcus [J. Chem. Phys. 53, 3188 (1970)] proposed a conformal transformation that maps an infinite chevron in the complex Jacobi coordinate $z=x+iy$ plane to an infinite strip in the $w=u+iv$ plane. u is the reaction coordinate; v is the (generalized) vibrational coordinate. We show that computational difficulties associated with this transformation can be partially removed by either of two methods of mapping part of the w-plane strip into an infinite strip in a third plane, $t=r+is$. The first method introduces "dipole pairs" in the w plane. The second introduces a slit in the w-plane strip. Relative advantages of the two methods are discussed. A Connor–Marcus-like map from a semi-infinite trapezoid to a semi-infinite rectangle is also derived for inelastic scattering calculations. (auth)

27262 QUANTUM COLINEAR INELASTIC AND REACTIVE SCATTERING WITH PIECEWISE ANALYTIC WAVEFUNCTIONS. Rosenthal, A.; Gordon, R.G. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). J. Chem. Phys. 64: No. 4, 1641-1658 (15 Feb 1976).

Piecewise analytic scattering wavefunctions are constructed for colinear models of inelastic and reactive scattering systems, using piecewise analytic vibrational basis sets and reaction coordinates defined by conformal transformations. Various approximate and exact methods for computing basis transformation matrices are discussed. Also presented are a compact formalism for extracting transmission and reflection coefficients (S-matrix elements) from the wavefunctions, and a method for transforming the wavefunctions from one coordinate system to another. Model potential surfaces used include two models of inelastic scattering (harmonic oscillator–exponential repulsion and harmonic oscillator–Lennard-Jones) and a colinear Porter–Karplus H_3 surface. Transmission and reflection probabilities from converged close-coupled calculations on the latter surface from threshold to −3.1 eV are presented. The number of closed channels used and the calculated probabilities are consistent with previously reported calculations. (auth)

27263 ELECTRONIC-ENERGY EXCHANGE CROSS SECTIONS FOR Ar* (^3P) AND Kr(^1S). Winicur, D.H.; Fraites, J.L.; Bentley, J. (Chemistry Department and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 64: No. 4, 1724-1732 (15 Feb 1976).

Differential cross sections for Ar* scattered by Kr are obtained at four relative kinetic energies, 60.6–156 meV. Location and shape of rainbow maxima, observed at all the energies, are used to determine parameters for a double-Lennard-Jones potential. The parameters, $\epsilon=9.11\pm0.25$ meV and $r_m=5.06\pm0.84$ Å are the same as those for K+Kr and are substantially different from those of Ar+Kr. A second set of maxima, visible at all energies and caused by exchange of electronic energy from Ar* to Kr, are analyzed to determine electronic-energy exchange cross sections. The cross sections together with those obtained from thermal-energy quenching measurements are consistent with an increase from a threshold of 25 meV. Possible mechanisms for the electronic-energy exchange are discussed. (auth)

27264 LOW-ENERGY DIFFERENTIAL ELASTIC SCATTERING OF NE* (^3P) BY Kr(^1S). Winicur, D.H.; Fraites, J.L.; Bentley, J. (Chemistry Department and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 64: No. 4, 1757-1761 (15 Feb 1976).

Differential elastic cross sections for Ne* (^3P) scattered by Kr are obtained at three relative kinetic energies, 64 to 74 meV. Location and shape of rainbow maxima, observed at all energies, are used to determine the well depth and potential minimum for a double-Lennard-Jones potential. The results, $\epsilon=8.05\pm0.49$ meV, and $r_m=4.91\pm0.64$ Å are similar to those for Na+Kr and are substantially different from those of Ne+Kr. A value of 2.11 Å for the atomic radius of Ne* is obtained which is close to that previously reported for Na. (auth)

27265 CHARGE TRANSFER REACTIONS OF ATOMIC IONS WITH POLYATOMIC MOLECULES. Hedrick, A.F.; Moran, T.F. (School of Chemistry, Georgia Institute of Technology, Atlanta, Georgia 30332). J. Chem. Phys. 64: No. 4, 1858-1860 (15 Feb 1976).

A time-of-flight technique has been used to measure the fast neutral Ar^0 products from charge transfer reactions of $Ar^+(^2P_{1/2}, {}^2P_{3/2})$ ions with neutral CO_2, CH_4, C_2H_4, and C_2H_6 molecules. Reaction cross sections were found to be independent of the electron energy (from threshold to 100 eV) used to produce reactant ion beams and indicates that essentially all the Ar^+ ions in the experimental apparatus are in the ground ^2P state prior to reaction. (AIP)

27266 ULTRAVIOLET EMISSION FROM CO_2^+ PRODUCED IN LOW-ENERGY He_2^+-CO_2 COLLISIONS. Bearman, G.H.; Harris, H.H.; Leventhal, J.J. (University of Missouri-St. Louis, St. Louis, Missouri 63121). Appl. Phys. Lett. 28: No. 6, 345-347 (15 Mar 1976).

Cross sections for production of electronically excited states of CO_2^+ in low-energy He_2^+-CO_2 collisions have been measured. The magnitudes of these cross sections are large enough to suggest the possibility of producing laser action at one or more wavelengths in an e-beam-initiated discharge in He-CO_2 mixtures. (auth)

27267 CROSSED-MOLECULAR-BEAMS INVESTIGATION OF THE EXCITATION OF GROUND-STATE NEON ATOMS BY 4.6-eV HELIUM METASTABLES. Leasure, E.L.; Mueller, C.R. (Chemistry Department, Purdue University, Lafayette, Indiana 47907). J. Appl. Phys. 47: No. 3, 1062-1064 (Mar 1976).

A molecular beam source has been developed which produces fast metastable helium atoms and was used in a crossed-molecular-beams experiment to measure the absolute differential elastic-collision cross section of these atoms with a velocity-selected beam of ground-state

neon atoms. The results at 4.6 eV c.m. show strong evidence of excitations around 5° and 8° c.m. The total excitation cross section was estimated at 1.45 Å² and probably originates from potential-energy curve crossings at 0.15 and 0.3 eV. (auth)

27268 ELECTRON-HYDROGEN ELASTIC SCATTERING IN THE EIKONAL APPROXIMATION. Foster, G.; Williamson, W. Jr. (Department of Physics and Astronomy, The University of Toledo, Toledo, Ohio 43606). Phys. Rev. A 13: No. 3, 936-940 (Mar 1976).

Differential and total cross sections for elastic scattering of electrons from atomic hydrogen have been calculated using the full eikonal approximation. The eikonal results for 50-, 100-, and 200-eV incident electrons are compared with other theoretical calculations and with recent experimental data. It is found that the full eikonal approximation predicts both small-angle differential cross sections and total cross sections, which are in better agreement with experiment than either the Born or Glauber results. (auth)

27269 STUDY OF THE *L*-SHELL X RAYS OF Ta, Pt, Au, Hg, AND Pb BY PROTON BOMBARDMENT. Chen, J.R.; Reber, J.D.; Ellis, D.J.; Miller, T.E. (Department of Physics, State University of New York, College at Geneseo, Geneseo, New York 14454). Phys. Rev. A 13: No. 3, 941-946 (Mar 1976).

The L x-ray transition ratios L (α_{12}/l), L (γ_1/η), L (η/γ_5), L (γ_{236}/γ_1), and L ($\gamma_{44'}/\gamma_1$) have been measured for the elements ^{73}Ta, ^{78}Pt, ^{79}Au, ^{80}Hg, and ^{82}Pb by ionization of the L-subshell electrons with 0.4–2.0-MeV proton bombardment. Transition-rate ratios L ($\gamma_{23}/\gamma_{44'}$) to the L_1 subshell, L (γ_6/γ_1), L (γ_1/η), and L (η/γ_5) to the L_2 subshell, and L (α_{12}/l) to the L_3 subshell have been extracted. Comparison of the extracted ratios with the relativistic Hartree-Fock model calculations of Scofield shows agreement within experimental errors for the L_1, L_2, and L_3 subshell ratios. A previously reported minimum in the Pb L (α_{12}/l) ratio between proton energies 1.0 to 1.5 MeV was not observed. Total L-shell production cross sections have also been measured for Pt and Au over the energy range 0.4–2.0 MeV and are found to be in good agreement with the predictions of the nonrelativistic plane-wave Born approximation and the constrained binary-encounter approximation, but not with the binary-encounter approximation. (auth)

27270 EXCITATION OF THE Sr AND Sr⁺ RESONANCE LINES BY ELECTRON IMPACT ON Sr ATOMS. Chen, S.T.; Leep, D.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80309). Phys. Rev. A 13: No. 3, 947-952 (Mar 1976).

The relative optical excitation functions and polarizations of the Sr resonance line (4607 Å) and of the Sr⁺ resonance lines (4078 and 4216 Å) have been measured, using crossed electron and strontium-atom beams, for electron energies from the excitation thresholds to 1497 eV. The electron-beam energy resolution was ~ 0.22 eV for energies below 13 eV, and the atom beam was optically thin. The excitation functions of the ionic lines were measured relative to that of the atomic resonance line at fixed energies near the maxima of the excitation functions. Using spontaneous-emission branching ratios, this yields the ratios of total excitation cross sections for the atomic and ionic resonance levels (including cascades). The Sr $5\,^1P$ excitation function has been normalized to Born theory taking account of cascade at 1497 eV, where the energy dependence of the excitation function has converged to the theoretical behavior. The resulting normalized cross sections have been compared with available theoretical calculations and other measurements. The 4607-Å polarization function is consistent with the theoretical threshold limit within experimental uncertainty. (auth)

27271 *K*-SHELL X–RAY PRODUCTION CROSS SECTIONS FOR 1.0–4.4-MeV α PARTICLES ON SELECTED THIN TARGETS OF $Z = 22$–34. Soares, C.G.; Lear, R.D.; Sanders, J.T.; Van Rinsvelt, H.A. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32611). Phys. Rev. A 13: No. 3, 953-957 (Mar 1976).

K-shell x-ray production cross sections for 1.0–4.4 MeV α particles have been measured. The elements selected were Ti, V, Mn, Fe, Co, Ni, Cu, Zn, Ge, and Se, and all data were for thin targets evaporated onto thin carbon backings. The measured cross sections are compared with predictions of the plane-wave Born approximation (PWBA), the PWBA with binding-energy and trajectory corrections, and the binary-encounter approximation. It is found that the PWBA with both corrections fits the data best for all elements and energies considered. (auth)

27272 *K* X–RAY PRODUCTION CROSS SECTIONS FOR FOURTEEN ELEMENTS FROM CALCIUM TO PALLADIUM FOR INCIDENT CARBON IONS. Wheeler, R.M.; Chaturvedi, R.P. (State University of New York College, Cortland, New York 13045); Duggan, J.L.; Tricomi, J.; Miller, P.D. Phys. Rev. A 13: No. 3, 958-964 (Mar 1976).

Absolute *K*-shell x-ray production cross sections for thin Ca, Sc, Ti, V, Fe, Ni, Cu, Zn, Ge, Rb, Sr, Y, Zr, and Pd targets have been measured for incident carbon ions in the energy range from 8 to 36 MeV. Ionization cross sections are calculated from atomic *K*-shell fluorescence yields and compared to the theoretical predictions of the plane-wave Born approximation including binding energy, Coulomb deflection, and relativistic corrections. $K\alpha/K\beta$ ratios and the shifts in the characteristic $K\alpha$ and $K\beta$ energies indicate the existence of multiple ionization in the low-Z targets. (auth)

27273 SPECTROSCOPIC STUDIES OF THE CHARGE-TRANSFER REACTION $He^+ + Hg \rightarrow He + (Hg^+)^*$ AT THERMAL ENERGY. Graham, E. IV; Biondi, M.A.; Johnsen, R. (Physics Department, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. A 13: No. 3, 965-968 (Mar 1976).

The reaction $He^+ + Hg \rightarrow He + (Hg^+)^*$ has been studied at thermal energy in a drift-tube–mass-spectrometer apparatus fitted with a sapphire window for observing the light emitted from the electronically excited ions. Over the wavelength range 300–900 nm, the only emissions observed from the $(Hg^+)^*$ product ions are the 614.9-nm ($7p\,^2P_{3/2} \rightarrow 7s\,^2S_{1/2}$) and 794.4-nm ($7p\,^2P_{1/2} \rightarrow 7s\,^2S_{1/2}$) transitions, in approximately equal amounts. This equal branching in the case of reaction paths having substantially different energy defects, $\Delta\epsilon\,(\infty) = 0.27$ and 0.72 eV, respectively, is not explained by present theoretical models of the charge-transfer process. (auth)

27274 QUANTUM-MECHANICAL PHASE INTERFERENCE AND OPTICAL POLARIZATION IN LOW-ENERGY Na^+-Ne INELASTIC COLLISIONS. Tolk, N.H.; Tully, J.C.; White, C.W.; Kraus, J.; Monge, A.A.; Simms, D.L.; Robbins, M.F. (Bell Laboratories, Murray Hill, New Jersey 07974); Neff, S.H.; Lichten, W. Phys. Rev. A 13: No. 3, 969-984 (Mar 1976).

Pronounced oscillatory structure and strong optical polarization effects have been observed in emission cross sections for the production of optical radiation measured as a function of energy in low-energy (100 eV to 6 keV) Na^+-Ne atomic collisions. Highly regular oscillatory structure found in the energy dependence of the emission cross sections for ten Ne I($3p \rightarrow 3s$) optical transitions is observed to be in antiphase with similar structure in two Na I($3p \rightarrow 3s$) optical emission cross sections. In addition, large polarization effects have been observed in optical radiation from excited $J \neq 0$ states. In one particular case involving a $J = 1$ to $J = 0$ transition, oscillations in the excitation function appear to arise exclusively from the polarization component of the radiation perpendicular to the beam direction. These observations indicate strong sublevel-state selection processes associated with collisional quantum-mechanical phase-interference phenomena. A simple model is presented which allows us to uniquely determine for the first time the quasimolecular states responsible for such oscillatory structure and consequently associated with each polarization component. Analysis based on the model for the case of the Na* ($3p$) radiation data indicates that the oscillatory structure is not attributable to interactions between simple single-electron diabatic states as believed previously. Similar analysis of the Ne* ($3p$) radiation data uniquely identifies the $^1\Pi$ ($\Omega = \pm 1$) and $^3\Pi$ ($\Omega = \pm 2$) molecular states as the major contributors. (auth)

27275 CHARGE TRANSFER IN $He^+ + Li$ AND $He^+ + Cd$ COLLISIONS. Auciello, O.; Alonso, E.V.; Baragiola, R.A. (Centro Atómico Bariloche, Comisión Nacional de Energia Atómica, Instituto de Física Dr. José A. Balseiro, Universidad Nacional de Cuyo, Bariloche, Argentina). Phys. Rev. A 13: No. 3, 985-986 (Mar 1976).

The charge-transfer cross sections σ_{10} for He^+ ions on vapors of lithium and cadmium have been measured using the method of charge analysis of the fast products of the collisions in a magnetic field. The cross section for lithium falls with energy and that for cadmium rises with energy in the measured energy range 5–44 keV. (auth)

27276 H^- FORMATION IN PROTON-HELIUM COLLISIONS. Roy, K.; Mukherjee, S.C.; Sural, D.P. (Department of Theoretical Physics, Indian Association for the Cultivation of Science, Jadavpur, Calcutta 700032, India). Phys. Rev. A 13: No. 3, 987-991 (Mar 1976).

The process of formation of H^- as a result of double electron capture by protons from helium is investigated using an atomic-state expansion in which three traveling atomic orbitals have been retained. The cross sections have been presented for incident proton energy ranging from 10 to 200 keV. The results are compared with the previous experimental and theoretical values. Our results show a maximum in the cross-section energy curve in qualitative agreement with the experimental findings. (auth)

27277 *K* AND *L* X RAYS INDUCED BY 5-MeV/amu α-PARTICLE AND NITROGEN-ION BOMBARDMENT OF TEN TARGET ELEMENTS RANGING FROM Cr TO Bi. Awaya, Y.; Izumo, K.; Hamada, T.; Okano, M.; Takahashi, T.; Hashizume, A.; Tendow, Y.; Katou, T. (The Institute of Physical and Chemical Research, Wako-shi, Saitama, 351 Japan). Phys. Rev. A 13: No. 3, 992-999 (Mar 1976).

The *K* and *L* x rays from ten target elements from Cr to Bi bombarded by 5-MeV/amu α particles and N ions were measured by a Si(Li) detector. Energy shifts of *K* x rays and intensity ratios of

$K\beta/K\alpha$, $L\alpha/Ll$, $L\alpha/L\beta$, $L\alpha/L\gamma$, and L/K were determined by analyzing the experimental results. The ratio of the reduced K-shell ionization cross sections, R_{2K}, showed a systematic deviation from the Z_1^2 dependence. (auth)

27278 CROSS-SECTION MEASUREMENTS FOR ELECTRON-H_3O^+ RECOMBINATION. Heppner, R.A.; Walls, F.L.; Armstrong, W.T.; Dunn, G.H. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). Phys. Rev. A 13: No. 3, 1000-1011 (Mar 1976).

Cross sections for electron-H_3O^+ recombination have been measured over an electron energy range of 0.060–1.15 eV by using a trapped-ion technique to contain an ion sample at a temperature of $\simeq$400 K. The cross section deduced from these measurements can be represented by $\sigma = 4.6 \times 10^{-18} E^{-2.9}$ cm^2 for $0.038 < E \leqslant 0.110$ eV; $\sigma = 4.8 \times 10^{-16} E^{-0.79}$ cm^2 for $0.110 < E \leqslant 0.420$ eV; and $\sigma = 7.5 \times 10^{-17} E^{-2.9}$ cm^2 for $E > 0.420$ eV. Uncertainties are estimated to be at the ± 50% level. Recombination-rate coefficients were calculated from the deduced cross sections, assuming a Maxwellian electron velocity distribution and trial forms for the cross section below 0.038 eV. Assuming the theoretical E^{-1} behavior for the cross section just above zero energy and comparing with the measured rate coefficient of Leu *et al.* at 540 K, we can deduce consistent cross sections below 0.038 eV to be $\sigma = 6.0 \times 10^{-15} E^{-1}$ cm^2 for $0 < E < 0.023$ eV, and $\sigma = 4.6 \times 10^{-18} E^{-2.9}$ cm^2 for $0.023 < E < 0.038$ eV. The calculated rate coefficients have temperature dependence $T^{-0.5}{}_e$ at 50 K and $T^{-1.43}{}_e$ at 10^5 K, and values of the coefficient are in good agreement with all direct measurements. (auth)

27279 ELECTRON CAPTURE INTO EIGHT EXCITED STATES OF ^{7}Li IN COLLISIONS OF 2-keV $^7Li^+$ ON H_2. Blaney, B.L.; Berry, R.S. (The University of Chicago, Department of Chemistry, Chicago, Illinois 60637). Phys. Rev. A 13: No. 3, 1034-1042 (Mar 1976).

We have measured relative intensities of emission from the 2*p*, 3*s*, 3*p*, 3*d*, 4*s*, 4*d*, 5*s*, and 5*d* states of ^{7}Li produced in 444-eV (relative energy) collisions (2-keV ions on thermal molecules) of $^7Li^+$ with H_2. From these, relative values of the direct charge-transfer cross sections σ_c were obtained. It was found that σ_c decreases rapidly and smoothly (approximately as $10^{-(n-3)}$), with increasing principal quantum number n (for $n = 3, 4, 5$) while the variation in σ_c with angular momentum quantum number is not regular; $\sigma_c(3s) \sim \sigma_c(3p)$ but $\sigma_c(nd) \sim 10\sigma_c(ns)$, in sharp contrast to the behavior of capture cross sections at high energies. (auth)

27280 POSITRON-HYDROGEN ELASTIC SCATTERING IN THE EIKONAL APPROXIMATION. Foster, G.; Williamson, W. Jr. (Department of Physics and Astronomy, The University of Toledo, Toledo, Ohio 43606). Phys. Rev. A 13: No. 3, 1265-1268 (Mar 1976).

The full eikonal approximation has been used to calculate differential and total cross sections for the elastic scattering of 50-, 100-, and 200-eV positrons from atomic hydrogen. The eikonal results are compared with other theoretical calculations and with the corresponding electron scattering cross sections. The electron and positron cross sections are found to differ as expected, in contrast to the Born and Glauber approximations which predict identical cross sections for both electron and positron scattering. Although no experimental results are available for comparison with our calculated cross sections, our results indicate that the full eikonal method may be useful for the calculation of positron (or proton) -atom scattering cross sections. (auth)

27281 ELECTRON-IMPACT EXCITATION OF TRIPLET LEVELS IN HELIUM. van Raan, A.F.J. (Faculty of Physics, University of Bielefeld, Bielefeld, Germany); van Eck, J. Phys. Rev. A 13: No. 3, 1276-1277 (Mar 1976).

It is argued that recent results of Showalter and Kay show a reasonable agreement (20%) with recent work of our group concerning the absolute values of the excitation cross sections. However, the analysis of the measured data performed by Showalter and Kay may introduce uncertainties into their triplet excitation functions, especially at higher energies. (auth)

27282 SEMIEMPIRICAL ANALYSIS OF ELECTRON-INDUCED *K*-SHELL IONIZATION. Quarles, C.A. (Texas Christian University, Fort Worth, Texas 76129). Phys. Rev. A 13: No. 3, 1278-1280 (Mar 1976).

We report the results of an analysis of the available experimental data on electron-induced *K*-shell ionization which show that the data can be described by the Bethe theory of ionization corrected for relativistic energies by a classical correction. This analysis, which extends over five orders of magnitude in the ratio of bombarding energy to ionization potential, appears to be superior to the available theoretical treatments, and suggests where further work would be useful. (auth)

27283 SLOW POSITRONS IN GASES. Massey, S.H. (University College, London). Phys. Today 29: No. 3, 42-51 (Mar 1976).

While they share many of the properties of negative electrons, positrons exhibit other phenomena—such as annihilation or positronium formation in collisions with atoms or molecules—that are all their own. (auth)

27284 DEVIATIONS FROM THE RUTHERFORD CROSS SECTION IN SUPERHEAVY QUASI-MOLECULES. Schaefer, W.; Soff, G. (Univ., Frankfurt am Main). Nuovo Cim.; 31B: No. 2, 250-256(11 Feb 1976).

The deviation from the Rutherford cross section of heavy ions caused by the electronic binding in superheavy quasi-molecules was calculated using the numerical solution of the two center Dirac equation. It varies from 5.2% at $\theta = 5°$ to 1.2% at $\theta = 90°$ up to 0.9% at $\theta = 175°$, where θ is the scattering angle in the $_{92}U$-$_{92}U$ center-of-mass system. Smaller deviations were found for the $_{28}Ni$-$_{28}Ni$ and $_{53}I$-$_{79}Au$ systems. The dependence on the occupation number and the influence of inner electronic interaction are discussed. Experimental verification of the scattering cross section would lead to a γ-ray–independent test of adiabatic formation of electronic states in superheavy quasi-molecules. (auth)

27285 OPTIMUM-INDEX METHOD. Frank, W. M. (Naval Surface Weapon Center, Silver Spring, MD). Nuovo Cim.; 31B: No. 2, 257-271(11 Feb 1976).

A convenient method is presented for the evaluation in the asymptotic limit of the ratio of two entire functions of the same order and type. The coefficients in the power series must be positive, which restricts applications to scattering theory to repulsive potentials only. (auth)

27286 RESONANCE STRUCTURES IN THE POLARIZATION OF HELIUM LINES EXCITED BY ELECTRON IMPACT IN THE 56–66 eV ENERGY RANGE. Defrance, A. (Rennes-1 Univ., 35 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 24, 765-768(23 Jun 1975). (In French)

The polarization functions are given by comparison with the excitation functions for transitions $4\ ^3D$-$2\ ^3P$(4,471A), 4^1D-2^1P (4,922A), 3^3P-2^3S(3,889A), 4^3P-2^3S(3,187A). The energy scale of the incident electrons is calibrated. Important differences are observed in polarization structures particularly between the triplet and the singlet state. Structure shifts are also observed in the excitation functions: these shifts are different according to the transition and according to the structure. (FR)

27287 REACTIONS OF THE IONS CH_3^+ AND CD_2H^+ AND CD_4. Constantin, E. (Faculte de Physique, Cluj); Abbe, J. C. Rev. Roum. Chim.; 20: No. 9-10, 1329-1334(1975). (In French)

The results from a study of the ion-molecule reactions in the systems $CH_3^+(CH_3D) + CH_4$ and $CD_2H^+(CHD_3, CH_2D_2) + CD_4$ are reported. The nature of the secondary ions, the cross sections as a function of the energy of the primary ions, and the reaction mechanisms are discussed. (tr-auth)

27288 VELOCITY DISTRIBUTION FUNCTIONS IN LORENTZ PLASMA. Kostritsa, A. A.; Savel'ev, V. L. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 22-27(1974). (In Russian)

Curves were found by the Monte Carlo method for the velocity distribution functions of particles in an electrical field. Their difference from Maxwell and Druivestain distributions (in the case of constant collision frequencies and constant scattering cross section, respectively) with the increase of the ratio of the charged particle mass and the atom scatterer was shown. Only elastic collisions were considered. A comparison with the emission consequences from the kinetic equation was made. (tr-auth)

27289 EVALUATION OF THE OFF-SHELL MATRIX ELEMENT FOR THE DIRECT PROCESS OF e^--H SCATTERING. Ghosh, A. S.; Purkayastha, G. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 49: No. 3, 171-176(Mar 1975).

The off-shell matrix element of the operator $Y_{11}^{(1)}$ for the direct process required in the Faddeev equations as input was evaluated analytically. The first order term of the perturbation series was retained and the two-body nonseparable operators were replaced by the corresponding interaction potentials. (auth)

27290 ELASTIC SCATTERING OF ELECTRONS AND POSITRONS BY SODIUM ATOMS. Guha, S. (Lady Brabourne Coll., Calcutta); Ghosh, A. S. Indian J. Phys.; 49: No. 3, 177-181(Mar 1975).

The eikonal approximation was used to investigate e^+-Na elastic scattering in the energy region E = 1 to 500 eV. In addition to the static potential, the effect of polarization potential which plays a key role in the low and intermediate energies was also included explicitly. Results for the total cross section of e^--Na scattering in the energy region $3 \lesssim E \lesssim 10$ eV are in close agreement with the recent experimental results and in the energy region $10 \lesssim E \lesssim 500$ eV. The present results are very close to first Born approximation. There is a discrepancy between the present results and the available experimental findings in the energy region 10 to 50 eV. The results for e^+-Na scattering were also given. (auth)

27291 TABLES OF TRANSPORT COLLISION INTEGRALS FOR (n,6,4) ION-NEUTRAL POTENTIALS. Viehland, L. A. (Brown Univ., Providence, RI); Mason, E. A.; Morrison, W. F.; Flannery, M. R. At. Data Nucl. Data Tables; 16: No. 6, 495-514 (Dec 1975).

Transport collision integrals are tabulated for the (n,6,4) model of ion-neutral-molecule interactions as functions of effective ion temperature for eight values of n and several values of a parameter gamma that measures the relative strengths of the r^{-6} and r^{-4} attraction terms. The ions can have any charge and the neutral entities can be either atoms or spherically symmetric molecules. The accuracy of the calculations is estimated to be a few parts in 10^4. The tables can be used to estimate ion-neutral potentials by comparison with experimental ion mobility data or conversely can be used to estimate ion mobilities and diffusion coefficients as functions of gas temperature and electric field strength from fragmentary information. (auth)

27292 X RAYS FROM FOIL-EXCITED IODINE BEAMS. Cocke, C. L. (Kansas State Univ., Manhattan); Varghese, S. L.; Bednar, J. A.; Bhalla, C. P.; Curnutte, B.; Kauffman, R.; Randall, R.; Richard, P.; Woods, C.; Scofield, J. H. Phys. Rev., A; 12: No. 6, 2413-2419(Dec 1975).

M-x-ray spectra from foil-excited iodine beams between 40 and 62 MeV have been studied using a bent-crystal spectrometer. The prompt spectrum is so rich as to defy analysis, but the delayed spectrum exhibits a number of resolved lines. Electric quadrupole 4s yields 3d transitions are observed from metastable systems in the NiI, CuI, and ZnI isoelectronic sequences. Electric dipole 4p yields 3d transitions from states in these isoelectronic sequences also appear downstream. Transition energies and quadrupole lifetimes have been measured and are compared with the results of both relativistic and nonrelativistic calculations. (auth)

Atomic Theory

Refer also to abstract 27237.

27293 MANY-ELECTRON CORRELATIONS IN SEMIEMPIRICAL THEORIES OF ELECTRONIC STRUCTURE. Misurkin, I.A. Opt. Spectrosc. (USSR) 39: No. 4, 347-349 (Oct 1975).

The derivation of the effective Hamiltonian in semiempirical theories of electronic structure was examined using a restricted atomic orbital basis. It was shown that terms describing many-body correlation interactions appear in the effective Hamiltonian because of the restricted nature of the basis. The concept of an average field for the many-body correlation interactions is introduced, and using the example of atomic systems the way in which many-body correlation energies enter into the effective parameters of the Hamiltonian is shown. The development of this formalism advances the understanding of the reasons for the successes and failures of semiempirical theories of the electronic structure of atomic and molecular systems. (auth)

27294 PHOTOELECTRIC ATOMIC ABSORPTION CROSS SECTIONS FOR ELEMENTS Z = 6 TO 54 IN THE MEDIUM ENERGY X-RAY RANGE 5 TO 25 keV. Pt. 2. A Comparison With Other Theoretical and Experimental Data. Stephenson, J. D. (Max-Planck-Gesellschaft zur Foerderung der Wissenschaften e.V., Berlin (F. R. Germany). Fritz-Haber-Institut). Z. Naturforsch., a; 30: No. 9, 1133-1142(Sep 1975).

A comparison is made between recent computations of X-ray photoeffect absorption cross sections, using screened hydrogen-like eigenfunctions, given in Part I[1], and those of an alternate more rigorous theory together with those estimable from experimental X-ray absorption coefficients. Some inherent limitations, which restrict the present results, are discussed. Photoeffect mass absorption coefficients for a limited number of elements between Z = 10 and 39 are determined from the hydrogen-like theory, using five characteristic X-ray energies from NiLα 1 (0.852 keV) to TiLα 1 (4.511 keV). (DE)

27295 ANALYTICAL SOLUTION OF THE THOMAS-FERMI EQUATION FOR THE IONIZED STATE OF THE ATOM. Plindov, G. I.; Dmitrieva, I. K. (Inst. of Nuclear Energy, Minsk). Dokl. Akad. Nauk BSSR; 19: No. 9, 788-791(Sep 1975). (In Russian)

An analytical solution of the Thomas-Fermi equation is obtained in the form of a series expansion. Formulas are derived on the basis of the expansion which describe the dependence of the ion radius and binding energy on N and Z. (JSR)

27296 DESCRIPTION OF EFFECTS OF GROUND STATE OPTICAL PUMPING WITH MODULATED LIGHT BASED ON A DRESSED-ATOM MODEL. Kolwas, K.; Kolwas, M.; Rosinski, K. (Inst. of Physics, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 10, 1133-1137(1975).

Interaction of an atomic system with light modulated at the ground state Zeeman frequency is analyzed using the dressed atom method. The dependence of effects expected in the light absorption on the geometry of the experimental arrangement and light polarization is given. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 27006.

27297 (LA-6191-MS) STABILITY OF THE FLOW IN A SHOCK LAYER. White, G. N. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1975. Contract W-7405-eng-36. 11p. Dep. NTIS $4.50.

The interior stability of an isothermal shock is studied as an initial value problem for inviscid one- and two-dimensional perturbations and as an initial-boundary value problem for viscous one-dimensional perturbations. The initial steady velocity profile is linear with finite width. Results, obtained from energy integral estimates, indicate stability at low Mach numbers and instability for large Mach numbers. (auth)

27298 (UCRL-Trans-10772) CALCULATING A MAGNETIC GAS-DYNAMIC FLOW PAST A BODY. Berezin, Yu. A.; Kovenya, V. M. Translated from Chislennye Metody Mekh. Sploshnoi Sredy; 4: No. 4, 15-29(1973). 21p. Dep. NTIS $3.50.

A numerical method of calculating two-dimensional supersonic flow of a viscous, heat-conducting gas around bodies of finite length within the framework of complete equations of single-fluid magnetic gas dynamics is proposed and the results of the solution of this problem are given for the case of a wedge. (auth)

27299 SURFACE TENSION OF He^4 AND T_λ. Magerlein, J.H.; Sanders, T.M. Jr. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. Lett. 36: No. 5, 258-261 (2 Feb 1976).

We have measured the surface tension of liquid He^4 for $(T_\lambda - 100$ mK$) < T < (T_\lambda + 100$ mK$)$ with a resolution of 1×10^{-5} using a capacitive differential-capillary-rise technique. The results show a change in the slope of σ (T) of 0.0226 ± 0.001 erg cm^{-2} K^{-1} centered below the bulk T_λ. A discussion of the critical behavior is given. (auth)

27300 SUPERFLUID PHASES OF HELIUM THREE. Wheatley, J.C. (University of California, San Diego). Phys. Today 29: No. 2, 32-45 (Feb 1976).

Magnetic superfluid phases in the low-millikelvin region, a Josephson "ringing" effect and fluid anisotropy are among the exotic properties of this surprising substance. (auth)

27301 EVIDENCE FOR MACROSCOPIC VORTEX-POROUS-DISK INTERACTION IN HELIUM II. Lynch, R.F.; Pellam, J.R. (Physics Department, University of California, Irvine, California 92717). Phys. Rev. Lett. 36: No. 7, 369-372 (16 Feb 1976).

We describe measurements of the liquid-helium-flow behavior of Millipore (porous) disks. Our findings lead us to hypothesize a novel effect: Quantum vortices, "destroyed" when the superfluid passes through the porous material, deposit their angular momentum causing an observable, macroscopic torque on the disk. Many different aspects of our data are shown to be in excellent agreement with this model. We present measurements of the temperature and speed dependence of the vortex-induced torque. (auth)

27302 SURFACE TENSION OF LIQUID ^{4}He NEAR T/sub lambda/. Magerlein, J. H. Ann Arbor, MI; Univ. of Michigan (1975). 169p. University Microfilms Order No. 75-29,279.

Thesis (Ph. D.).

The surface tension of liquid ^{4}He has been measured in the temperature range T/sub lambda/-100 mK less than T less than T/sub lambda/ + 100 mK with a resolution of about 1 part in 10^5. The technique employs the differential capillary rise between a pair of guarded coaxial capacitors with different gap widths. Short-term noise corresponds to fluctuations in the surface tension of about 1 part in 10^5. Systematic errors in sigma(T) - sigma (T/sub lambda/) are estimated at less than 3 parts in 10^4 of the total surface tension over the temperature range investigated. The data are consistent with previous surface tension measurements. The data has been compared with several theoretical suggestions, which predict singular surface tension terms. The data are inconsistent with a mean-field theory calculation by Sobyanin. Our data are better described by singular terms, proposed by Hohenberg, resulting from fluctuations on both sides of T/sub lambda/. The data are also described well by a sum of mean-field and fluctuation terms. (Diss. Abstr. Int., B)

27303 COMPARISON OF UNSTABLE MODES AND GROWTH RATES IN IDEAL MAGNETOHYDRODYNAMICS AND GUIDING CENTER PLASMAS. Weitzner, H. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). Phys. Fluids 19: No. 3, 420-426 (Mar 1976).

Unstable modes and growth rates are compared for helically symmetric equilibria based on the models of ideal magnetohydrodynamics and guiding center plasmas. After appropriate expansions and approximations, it is shown that any unstable mode in ideal magnetohydrodynamics is present in exactly the same form and with the same growth rate in a guiding center plasma. Except for a small class of modes whose existence is doubted but cannot be proved with the analysis given, the converse statement also holds. (auth)

27304 MAGNETOHYDRODYNAMIC SPECTRUM IN A CLASS OF TOROIDAL EQUILIBRIA. Spies, G.O. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). Phys. Fluids 19: No. 3, 427-437 (Mar 1976).

A normal mode analysis is performed for small amplitude magnetohydrodynamic motions about arbitrary, axially symmetric, static equilibria with purely poloidal magnetic fields. It is shown that the maximum growth rate pertaining to a fixed azimuthal mode number m increases with $|m|$, and that the point eigenvalues become densely spaced in the limit $|m|\to\infty$, thus forming an unstable continuum. For large $|m|$, the determination of the normal modes is reduced to a problem in ordinary differential equations, and the dependence of the point eigenvalues on mode numbers is studied. As a practical consequence, it is found that the criterion derivable from the energy principle through trial functions localized at a pressure surface is necessary for gross stability (i.e., for stability of modes with small mode numbers). This conclusion does not apply to equilibria with shear. (auth)

27305 STUDY OF FLOW AROUND INSULATING AND CONDUCTING CYLINDRICAL OBSTACLES IN PRESENCE OF A TRANSVERSAL MAGNETIC FIELD. Vives, C. (Centre Universitaire d'Avignon, 84 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 22, 677-680(9 Jun 1975). (In French)

Evolution of the stagnation point pressure and of the azimuth θ_N corresponding to the minimal value of the pressure in function of Reynolds and Hartmann number. The drag coefficient variations are studied in a field marked by $93 \le Re \le 11{,}600$ and $0 \le M < 160$. (FR)

27306 ON THE ESTABLISHED CHARACTERISTICS AND STABILITY OF THE UPSTREAM AND DOWNSTREAM WAKES. Lobo Hidalgo, M. (Universidad Autonoma de Madrid (Spain)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 22, 1555-1557 (9 Jun 1975). (In French)

The MHD flow with aligned fields at infinity past a body in the far wake approximation is considered. In the case where two wakes, upstream and downstream, are present, by studying them separately (resp. as a coupled system) they are unstable (resp. stable) for both steady and unsteady small perturbations. (FR)

27307 WAVES AND DISCONTINUITIES IN RELATIVISTIC AND ANISOTROPIC MAGNETOHYDRODYNAMICS. Cissoko, M. (College de France, 75- Paris). Ann. Inst. Henri Poincare, Sect. A; 22: No. 1, 1-27(1975). (In French)

This work is devoted to the relativistic study of a non-dissipative anisotropic fluid diagram of infinite conductivity. Such a fluid diagram is constructed in part one. Starting from a macroscopic viewpoint a hydrothermodynamic study of the fluid diagram considered is carried out and the fundamental differential system of anisotropic magnetohydrodynamics is deduced. Part two concerns the study of characteristic varieties and propagation of waves for a polytropic anisotropic fluid diagram. Three types of characteristic varieties are revealed: entropy waves (or material waves), magnetosonic waves and Alfven waves. The propagation rates of Alfven and magnetosonic waves are situated with respect to each other. The study of wave cones showed up on the one hand certain special features of wave propagation in anisotropic magnetohydrodynamics and on the other hand the hyperbolic nature of differential operators associated with the various waves. (FR)

27308 LIQUID AND SOLID HELIUM. Proceedings of the European Physical Society Topical Conference, Haifa, Israel, 1-4 July 1974. Kuper, C. G.; Lipson, S. G.; Revzen, M. (eds.). New York; John Wiley and Sons, Inc. (1975). 410p. (CONF-740725-). $32.00.

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974).

Abstracts of 38 papers appear separately in Nuclear Science Abstracts. (SDF)

For abstracts of individual papers see: 25872-25874, 27310-27343, and 27862.

27309 APPLICATION OF THE THEORY OF DYNAMICAL POSSIBILITY OF MOTION TO THE MAGNETIC HYDRODYNAMICS. Zherbina, A. S.; Rubashev, B. M. (Pulkovo Glavnaia Astro-

nomicheskaia Observatoriia, Moscow). Izv. Gl. Astron. Obs. Pulkove; No. 192, 128-137(1974). (In Russian)

The theory of dynamical possibility of motion as applied to the magnetic hydrodynamics is investigated. The problem is considered in kinematic approximation. For an incompressible medium the motion appears to be possible dynamically if electromagnetic force would be a potential vector. It is found that since electromagnetic force is included in the motion equation like the viscosity force a condition of dynamical possibility motion for a compressible ideal hydrodynamical medium would be the same as for viscous compressible fluid and Friedman's theory may be applied in its initial form only in the case of a force free field. The following examples were considered: elucidation of dynamical possibility of a considered type motion at a given magnetic field and determination of the electromagnetic force components for a given type of motion and thus the determination of the magnetic field. In conclusion the problem of the magnetic field as a new dynamical element of motion is formulated. This may be significant for working out the dynamo-theory. (auth)

27310 LONG WAVELENGTH EXCITATIONS AND THE ATTENUATION OF SOUND IN LIQUID ^{4}He. Ketterson, J. B. Northwestern Univ., Evanston, IL); Abraham, B. M.; Roach, P. R. pp 3-27 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

A brief review is given of current understanding of the behavior of long wavelength excitations in liquid ^{4}He at very low temperatures and their dependence on pressure. A discussion is given of experiments which probe the excitation spectrum; these include inelastic neutron scattering, heat capacity, thermal conductivity, propagation of super thermal phonons, and sound propagation. Special emphasis is given to sound propagation. 20 figures. (auth)

27311 PHONON PROPAGATION IN LIQUID ^{4}He. Dynes, R. C.; Narayanamurti, V. (Bell Labs., Murray Hill, NJ). pp 29-38 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

Heat pulses and high frequency phonons (homega/2pi much greater than kT) are used to study phonon scattering rates in He II below 0.6 K. These measurements as a function of temperature and pressure indicate a T^3 dependence of the phonon-phonon scattering rate and that the excitation spectrum at low pressure and momentum curves upward. 6 figures. (auth)

27312 RAMAN SCATTERING FROM LIQUID He. Woerner, R. L. (Massachusetts Inst. of Tech., Cambridge). pp 39-48 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

A review is presented of the Raman scattering of light by liquid helium, and its role in determining the properties of the elementary excitations. In particular Raman measurements of the energy and linewidth of rotons in pure ^{4}He and superfluid ^{3}He–^{4}He solutions are discussed. 5 figures. (auth)

27313 DENSITY AND TEMPERATURE DEPENDENCE OF THE EFFECTIVE INTERACTION IN LIQUID He. Iachello, F. (Univ., Groningen, Netherlands); Rasetti, M. pp 49-52 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

A conjecture is made for the density and temperature dependence of the effective interaction in liquid He. On the basis of this ansatz and using a previously discussed form for the zero temperature behavior of alpha, which emphasizes the role of the hard core, both the superfluid phase transition curve and the roton thermodynamic behavior are calculated. 2 figures. (auth)

27314 STUDY OF FINE STRUCTURES IN RAMAN SPECTRA IN SUPERFLUID ^{4}He: DISPERSION AND INTERACTIONS OF ELEMENTARY EXCITATIONS. Ohbayashi, K.; Ikushima, A. (Tokyo Univ.). pp 53-56 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See Conf-740725-.

Fine structures in the Raman spectra in superfluid ^{4}He have been observed, which manifest the attractive interactions between elementary excitations. Three extremal energies of the phonon-roton dispersion curve have been determined as functions of temperature. 2 figures. (auth)

27315 THERMAL EXPANSION COEFFICIENT OF PRESSURIZED LIQUID HELIUM NEAR THE SUPERFLUID TRANSITION. Mueller, K. H. (Kernforschungsanlage, Juelich, Ger.); Pobell, F.; Ahlers, G. pp 57-61 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The thermal expansion coefficient of liquid ^{4}He has been measured under pressure, in the vicinity of the lambda-line. The ratio of the amplitudes of the singular part above and below the transition is approximately 1.1. Theoretical considerations suggest that this ratio should be independent of pressure. The experimental data support this prediction. 4 figures. (auth)

27316 SUPERFLUID HELIUM THREE: PAST AND PRESENT. Lee, D. M. (Cornell Univ., Ithaca, NY). pp 67-95 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

A history of the early theories of superfluid ^{3}He and the discovery of the A and B phases is given. Recent experimental results on the phase diagram, nuclear magnetic resonance, superfluid behavior and wave propagation phenomena are related to theory, wherever possible. 15 figures. (auth)

27317 REMARKS ON THE EXPERIMENTAL MAGNETIC PROPERTIES OF SUPERFLUID ^{3}He. Wheatley, J. C. (Univ. of California, San Diego). pp 97-105 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

In a new apparatus, the static magnetism of the B phase has been measured along the line T/sub AB/. The result is that there is no substantive change from the measurements obtained earlier in collaboration with Kojima, Johnson, and Paulson using a different apparatus. 7 figures. (auth)

27318 SUPERFLUIDITY OF ^{3}He. Yanof, A. W.; Reppy, J. D. (Cornell Univ., Ithaca, NY). pp 113-117 of Liquid and Solid Helium. Kuper, C. G. (Ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The superfluidity of the A phase of ^{3}He is established by the propagation of fourth sound. The measured velocity is consistent with a two-fluid model. The superfluid density agrees well with other measurements. 2 figures. (auth)

27319 HYDRODYNAMIC HEAT FLOW IN SUPERFLUID ^{3}He. Johnson, R. T.; Kleinberg, R. L.; Webb, R. A.; Wheatley, J. C. (Univ. of California, San Diego). pp 119-124 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

Measurements of the thermal conductivity in superfluid ^{3}He yielded the following conclusions. (1) heat flows hydrodynamically in ^{3}He for temperatures below T/sub c/. (2) The diffuse conductivity in parallel with the hydrodynamic conductivity is too small to measure. 3 figures. (SDF)

27320 POSSIBLE APPLICATION OF DYNAMIC POLARIZATION TO THE COOLING OF LIQUID ^{3}He. Chapellier, M. (Univ. of Copenhagen). pp 125-130 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

It is shown that dielectric substances are promising compounds to cool ^{3}He liquid. First, doped with paramagnetic impurities, they have an intrinsic heat conductivity which is not negligible. Second, big nuclear magnetic moments have been polarized by dynamic methods in dielectrics. Third, the nuclei are coupled to ^{3}He via the electronic spin-spin reservoir, provided that the external magnetic field is not too high. (auth)

27321 RELATIONSHIP BETWEEN NMR STUDIES AND SUPERFLUID DENSITY FOR ^{3}He A. Bernier, M. E. R.; Bozler, H. M.; Gully, W. J.; Richardson, R. C.; Lee, D. M. (Cornell Univ., Ithaca, NY). pp 131-134 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

Recent NMR results show that the axial state gives a good description for ^{3}He A. Within the framework of weak coupling

theory one can obtain a value for rho/sub s//rho for the axial state from the NMR results assuming that the line shift parameter omega, is proportional to the energy gap. The resulting values for rho/sub s//rho are compared with the similar theoretical calculation and other experimental results. 2 figures. (auth)

27322 TRANSVERSE AND LONGITUDINAL NMR IN LIQUID ^{3}He A. Bernier, M. E. R.; Gully, W. J.; Bozler, H. M.; Richardson, R. C.; Lee, D. M. (Cornell Univ., Ithaca, NY). pp 135-139 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

NMR measurements of the variation of the nuclear susceptibility with temperature and applied magnetic field in ^{3}He A are discussed. The width of the longitudinal resonance line in ^{3}He A is also reported. 2 figures. (auth)

27323 NEW PHASES OF LIQUID ^{3}He. Leggett, A. J. (Univ. of Sussex, Brighton, Eng.). pp 151-161 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The consequences of applying a BCS-like theory to the new A and B phases of superfluid ^{3}He are discussed. (SDF)

27324 CRITIQUE OF RENORMALIZATION METHODS FOR STRONG-COUPLING THEORIES IN THE NEARLY-FERROMAGNETIC REGION. Layzer, A. (Stevens Inst. of Tech., Hoboken, NY); Fay, D. pp 163-166 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

Basic strong-coupling postulates involved in the recent self-consistency based renormalization procedures, which greatly affect the calculated values of the superfluid T/sub c/ in ^{3}He, are examined and clarified. (auth)

27325 SPIN FLUCTUATIONS IN LIQUID ^{3}He: A STRONG-COUPLING CALCULATION OF T/SUB c/ AND THE NORMAL-STATE DISTRIBUTION FUNCTION. Fay, D. (Univ., Hamburg); Layzer, A. pp 167-170 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The Berk–Schrieffer method of strong-coupling superconductivity for nearly ferromagnetic systems is generalized to arbitrary L-state pairing and realistic (hard-core) potentials. Application to ^{3}He yields a P-state transition but very low values for T/sub c/ and an unsatisfactory normal-state momentum distribution. (auth)

27326 SUPERFLUID WITH MIXED SINGLET AND TRIPLET PAIRS. Eckstein, S. G.; Berger, J. (Israel Inst. of Tech., Haifa). pp 171-175 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

A model superfluid with attractive interaction for both singlet and triplet pairs has been investigated. The phase diagram of this model is compared with that of ^{3}He. 1 figure, 1 table. (auth)

27327 THERMODYNAMIC TEMPERATURE SCALE DERIVED FROM MEASUREMENT OF ^{3}He LATENT HEAT. Halperin, W. P.; Archie, C. N.; Rasmussen, F. B.; Richardson, R. C. (Cornell Univ., Ithaca, NY). pp 227-231 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The latent heat of ^{3}He has been measured along the melting curve from 20 mK to 1 mK. This establishes a thermodynamic temperature scale in units of the A-transition temperature. T/sub A/ is found to be 2.75 +- 0.14 mK using liquid specific heat data. (auth)

27328 MOTION OF IONS AND ION-VORTEX RING COMPLEXES IN LIQUID HELIUM II. van Dijk, J. D. P.; de Jonge, B. R.; Kramers, H. C. (Leiden Univ., Netherlands). pp 251-253 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

Preliminary results are given of experiments on the propagation of ions and charged vortex rings. A field emission source is used together with a pulsed current technique. (auth)

27329 PRECISE MEASUREMENT OF EFFECTIVE MASS OF POSITIVE AND NEGATIVE CHARGE CARRIERS IN LIQUID HELIUM II. Poitrenaud, J. (CEN, Saclay, France). pp 255-258 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The resonance of charge carriers in He II is observed. It is shown that the negative ion signal of the preceding experiment is, in fact, the first harmonic. The effective masses and the ionic radii are deduced. (auth)

27330 KAPITZA RESISTANCE AND RELATED PHENOMENA. Anderson, A. C. (Univ. of Illinois, Urbana). pp 261-270 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

It was demonstrated by Kapitza in 1941 that the flow of heat Q from a solid body to liquid helium produces a temperature discontinuity DELTA T at the interface. Early attempts to explain the thermal resistance DELTA T/Q in terms of phonon transmission met with little success, the theoretical values of DELTA T/Q were much too large. Of the numerous mechanisms suggested to augment the transfer of thermal energy across the interface, only a few have the support of experimental evidence. Mechanisms which apparently have been observed are the coupling to phonons, to individual quasi-particles, and to nuclear magnetic fluctuations in liquid ^{3}He. When the solid is metallic, the influence of the electron-phonon interaction has also been demonstrated. Nevertheless a full theoretical explanation of the thermal resistance DELTA T/Q still eludes us, especially in the temperature range near 1°K. Recent experiments indicate the diverse phenomena which theory must eventually incorporate. 4 figures. (auth)

27331 SURFACE STATES IN LIQUID HELIUM. Woo, C. W. (Northwestern Univ., Evanston, IL). pp 271-285 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

From considerations of the surface structure and excitations of pure liquid ^{4}He, we deduce microscopic properties of ^{3}He quasi-particles adsorbed on the surfaces of ^{3}He–^{4}He solutions and predict superfluid transitions in ^{3}He monolayers. 4 figures. (auth)

27332 EXPERIMENTAL TESTS OF BOUNDARY CONDITIONS AT THE FREE SURFACE OF LIQUID HELIUM. Wiechert, H.; Buchholz, F. I. (Johannes-Gutenberg-Univ., Mainz). pp 293-299 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The validity of boundary conditions at the free surface of liquid helium has been tested by measuring the acoustical coefficients of reflection, transmission and transformation of a sound wave incident normally on the surface from the vapor. The measurements are compared with the theory and show in some cases serious deviations from the theory. 3 figures. (auth)

27333 THICKNESS, DOPPLER SHIFT, SUPERFLUID DENSITY AND CRITICAL VELOCITY OF A FLOWING UNSATURATED HELIUM FILM. Rudnick, I. (Univ. of California, Los Angeles). pp 311-313 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

Third sound measurements on unsaturated helium films driven at constant velocity allow unambiguous determination of the critical velocity as a function of film thickness. (auth)

27334 SOME RECENT EXPERIMENTAL WORK ON HELIUM IN RESTRICTED GEOMETRIES. Brewer, D. F. (Univ. of Sussex, Brighton, Eng.). pp 315-328 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The properties of adsorbed helium films (mainly ^{4}He) are extensively reviewed. The variation of superfluid onset temperature, superfluid density, critical velocity, and specific heat with film thickness is discussed. The properties of adsorbed ^{3}He are briefly recounted. 10 figures. (auth)

27335 SUBSTRATE ENHANCED SUSCEPTIBILITY OF ADSORBED ^{3}He IN THE COLLISIONLESS REGIME. Creswell, D. J.; Brewer, D. F. (Univ. of Sussex, Brighton, Eng.). pp 329-334 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

An interpretation is given of some recent magnetic data concerning liquid ^{3}He confined to 71 A pores at low temperatures (0.05°K to 1°K). The susceptibility of the fluid in the center of the pores is believed to be elevated above the bulk liquid value at the lowest temperatures when the mean free path, lambda, becomes greater than the pore diameter. Such an effect could be of importance in boundary condition experiments on superfluid ^{3}He when lambda is comparable with the "healing length". (auth)

27336 EXPERIMENTS ON A MOVING SATURATED He II FILM WITH A LENGTH OF UP TO 200 METER. van Beelen, H.; van Spronsen, E.; Verbeek, H. J.; de Bruyn Ouboter, R.; Taconis, K. W. (Kamerlingh Omnes Laboratorium, Leiden). pp 335-338 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

Measurements on a moving He II film connecting two helium reservoirs are reported. Films with a length ranging from 20 to 200 m are studied. The observed slightly damped Atkins oscillations, the Kontorovich effect, third-sound effects and persistent film flow are discussed. (auth)

27337 WAVEGUIDE PARTIALLY PACKED WITH SUPERLEAK AS A PROBE OF SUPERFLUID PROPERTIES. Rosenbaum, R. (Tel Aviv Univ., Israel); Rudnick, I.; Rudnick, J. pp 339-342 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

A waveguide packed to a fraction of its cross-sectional height and filled with superfluid He has two low-lying propagating modes. The modes are briefly described. Preliminary experimental results appear to verify theoretical predictions concerning the modes. 3 figures. (auth)

27338 FOURTH SOUND IN POROUS MEDIA. Revzen, M.; Shapiro, B.; Kuper, C. G.; Rudnick, J. (Israel Inst. of Tech., Haifa). pp 343-346 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The velocity of fourth sound in liquid helium is calculated for the case where the liquid fills the interstices of a macroscopically isotropic porous medium of arbitrary porosity. (auth)

27339 PHENOMENOLOGICAL STATISTICAL DESCRIPTION OF HYSTERESIS OF PERSISTENT CURRENT IN LIQUID HELIUM. Joselson, B. Z.; Revzen, M. (Israel Inst. of Tech., Haifa). pp 347-350 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

A phenomenological statistical description is suggested for the experimental appearance of critical velocities and hysteresis effects in liquid ^{4}He persistent currents. The relative superfluid velocity is assigned with a set of states of fluctuation, with corresponding thermodynamical probabilities, in a manner closely related to the statistical treatment of Brownian motion. 2 figures. (auth)

27340 SURFACE EXCITATIONS IN THIN HELIUM FILMS. Washburn, T. E.; Rutledge, J. E.; Mochel, J. M. (Univ. of Illinois, Urbana). pp 351-354 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The temperature dependence of third-sound velocity below 0.7°K has been measured in thin helium films. We have observed phonon-like two-dimensional thermal excitations whose density is independent of film thickness for films thinner than 2.8 atomic layers. (auth)

27341 HOW WELL DOES THE SUPERFLUID TRANSITION OBEY SCALING AND UNIVERSALITY. Pobell, F. (Kernforschungsanlage, Juelich, Ger.). pp 357-373 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The results of experimental investigations of the superfluid transition of ^{4}He under pressure and of ^{3}He-^{4}He mixtures will be summarized, and compared with scaling, universality, and recent explicit calculations of critical parameters. The properties to be discussed are specific heat, thermal expansion coefficient, superfluid density, correlation length, attenuation of second sound, thermal conductivity, and mass diffusivity. 1 table, 10 figures. (auth)

27342 DILUTE SOLUTIONS OF ^{3}He IN SUPERFLUID ^{4}He. Disatnik, Y. (Tel Aviv Univ., Israel). pp 383-395 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

The theory of Bardeen, Baym, and Pines describing dilute solutions of ^{3}He in superfluid ^{4}He is reviewed. Thermodynamic properties of the solutions are discussed. (SDF)

27343 DETERMINATIONS OF ROTON-, MAXON- AND PLATEAU-ENERGIES IN ^{3}He-^{4}He MIXTURES BY RAMAN SCATTERING. Ohbayashi, K.; Ikushima, A. (Tokyo Univ.). pp 407-410 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974). See CONF-740725-.

By observing fine structures in Raman spectra, the energies of the roton, the maxon and plateau have been determined in the superfluid ^{3}He-^{4}He. 2 figures. (auth)

27344 HALL EFFECTS ON COMBINED FREE AND FORCED CONVECTIVE HYDROMAGNETIC FLOW THROUGH A CHANNEL. Mazumder, B. S.; Gupta, A. S.; Datta, N. (Indian Inst. of Tech., Kharagpur, India). Int. J. Eng. Sci.; 14: No. 3, 285-292(1976).

Hydromagnetic free and forced convection in a parallel plate channel permeated by a transverse magnetic field has been considered taking Hall effects into account. When there is a uniform axial temperature variation along the walls, the primary flow shows incipient flow reversal at the upper plate for an increase in temperature along that plate. Similarly flow reversal at the lower plate occurs for a decrease in temperature along that plate. Hall currents are found to exert a destabilizing influence on the flow. The skin-friction for the cross-flow increases with the Hall parameter. The induced magnetic field and the heat transfer characteristics in the flow are also determined. (auth)

27345 THREE DIMENSIONAL MHD LAMINAR SOURCE FLOW BETWEEN POROUS DISKS. Chandrasekhara, B. C.; Venkatachalappa, M.; Rudraiah, N. (Univ. Visvesvaraya, Bangalore, India). Indian J. Phys.; 5: No. 3, 225-240(Mar 1974).

The three dimensional magnetohydrodynamic laminar source flow between two infinite rotating porous insulating disks is investigated including the effect of induced radial electric field. The solution is obtained by perturbing the source free flow solution using reduced source Reynolds number R_s^* as the perturbation parameter. Asymptotic solutions are obtained for velocity perturbation when $R_w \ll M^2$, R_w and M being injection or suction Reynolds number and Hartmann number respectively. The interaction of source, injection, magnetic field and induced radial electric field with the flow are discussed in detail. It is observed that increase in source Reynolds number R_s^* decreases the magnitude of the angular velocity and increases the magnitude of radial velocity. Further it is noted that due to induced radial electric field there is a marked change in angular velocity profiles. (auth)

27346 NUMERICAL SIMULATION OF THE INTERACTION OF CHARGED PARTICLES WITH OBLIQUE MAGNETOHYDRODYNAMIC SHOCKS. Chen, G. L. Lawrence, KA; Univ. of Kansas (1975). 131p. University Microfilms Order No. 75-26,370.

Thesis (Ph. D.).

The motion of high energy charged particles in ideal oblique MHD shocks, characteristic of the interplanetary medium, has been studied extensively. The shock is treated as a plane surface across which the tangential component of magnetic field changes discontinuously. The orbits of charged particles can be solved exactly from Lorentz force equation and initial conditions of particles in each region, pre- and post-shock, separately. The essential procedure is to determine the crossings and that has been achieved by solving numerically for the times when the particle meets the shock. The position and velocity vectors are continuous across the shock. An ensemble of 1972 monoenergetic particles distributed isotropically in the shock frame are chosen to obtain collective results. (Diss. Abstr. Int., B)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 26077.

27347 HIGH ENERGY PHYSICS INDEX. Volume 13, No. 19, 1975. Leopoldshaften, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 96p.

27348 HIGH ENERGY PHYSICS INDEX. Volume 13, No. 26, 1975. Leopoldshaften, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 118p.

27349 HIGH ENERGY PHYSICS INDEX. Volume 13, No. 25, 1975. Leopoldshaften, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 114p.

27350 HIGH ENERGY PHYSICS INDEX. Volume 14, No. 1-2, 1976. Leopoldshaften, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 128p.

27351 HIGH ENERGY PHYSICS INDEX. Volume 14, No. 4, 1976. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 108p.

27352 HIGH ENERGY PHYSICS INDEX. Volume 14, No. 3, 1976. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1976). 105p.

27353 STATE OF HIGH ENERGY PHYSICS. Jentschke, W. K. CERN Cour.; 16: No. 1, 4-8(Jan 1976).

The review of high energy physics includes charm particles, the proton size, hadron spectroscopy and quarks, leptons as probes of the nucleons, structure revealed by proton–proton collisions at high energies, multiple production of particles in high energy collisions, the neutral current form of the weak interaction and charm, recent discoveries, and new lepton production processes. (JFP)

27354 PARTICLE DATA GROUP: GROWTH AND OPERATIONS. Eighteen Years of Particle Physics. Rosenfeld, A. H. (Lawrence Berkeley Lab., CA). Annu. Rev. Nucl. Sci.; 25: 555-598(1975).

A review is given of the growth of particle physics data as it relates to the collection, evaluation, correction, verification, analysis, and distribution by the Particle Data Group. (SDF)

Electromagnetic

27355 (CEA-N-1817(Suppl.), pp 18-19) PRECISION MEASUREMENT OF THE MAGNETIC MOMENT OF THE NEUTRON. Asghar, M.; Dress, B. W.; Laffon, J.; Miller, P. D.; Pendlebury, J. M.; Perrin, P.; Ramsey, N. F.; Servoz-Gavin, P. 1975.

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin No. 7, January-June 1975. ILL experiments. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

An experiment is planned in view of measuring the neutron magnetic moment with an accuracy of 3 parts in 10^7. It is proposed to compare the spin precession frequency of the neutron with that of the proton in the same magnetic field. The magnetic moment of the proton has recently been measured to one part in 10^8 and so the comparison will allow the neutron moment to be determined. (FR)

27356 EXPERIMENTAL STUDY OF NUCLEAR SHADOWING IN LOW-Q^2 ELECTROPRODUCTION. Eickmeyer, J.; Michalowski, S.; Mistry, N.; Talman, R.; Ueno, K. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. Lett. 36: No. 6, 289-291 (9 Feb 1976).

The total cross section for hadron production by inelastic electron scattering at 3.2° from a number of nuclei has been measured at several virtual photon energies at fixed $Q^2=0.1$ (GeV/c)^2. The hadronic cross section is measured directly, by detecting at least one hadron in coincidence with the scattered electron. The results show very little shadowing and no detectable energy dependence. These observations contradict vector-meson dominance. (auth)

27357 SEARCH FOR ρ-LIKE VECTOR MESONS IN THE MASS RANGE (1.2 TO 3.0) GeV. Bollini, D.; Giusti, P.; Massam, T.; Monari, L.; Palmonari, F.; Valenti, G.; Zichichi, A. (CERN, Geneva). Lett. Nuovo Cim.; 15: No. 11, 393-396(13 Mar 1976).

The reaction $e^+e^- \rightarrow \pi^+\pi^-$ in a colliding beam experiment was studied in a search for ρ-like mesons in the 1.2 to 3.0 GeV mass range. It was found that the cross section proportionality constant never exceeds a limit ten times below that of the known ρ meson. (JFP)

27358 NATURE OF ASYMMETRIC SHOWERS FORMED BY PROTONS IN THE MOMENTUM INTERVAL FROM 20 TO 200 GeV/c. Boos, E. G.; Takibaev, Zh. S.; Antonova, M. G.; Pavlova, N. P.; Shakhova, Ts. I.; Kholmetskaya, A. V.; Obodova, R. F. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 41-45(1974). (In Russian)

An analysis was made of the proton-nucleon interactions, formed in nuclear photoemulsions, according to the value of lg γ_s/γ_c. The fraction of the asymmetric shower at momenta of 19.8, 67, and 200 GeV/c was evaluated. (tr-auth)

Weak

27359 EXPERIMENTAL MEASUREMENT OF $K_L^0 \rightarrow \mu^+\mu^-$. Fukushima, Y.; Jensen, D.A.; Surko, P.; Thaler, J.J. (Department of Physics, Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540); Kreisler, M.N.; Lopez, A.M.; Shah, P. Phys. Rev. Lett. 36: No. 7, 348-351 (16 Feb 1976).

Using a spark-chamber magnet spectrometer and applying very stringent requirements to eliminate background contamination, we find three events of the rare process $K_L^0 \rightarrow \mu^+\mu^-$ corresponding to a branching ratio relative to $K_L^0 \rightarrow \pi^+\pi^-$ of $4.2^{+3.1}_{-2.6}\times10^{-6}$. Using the branching ratio $(K_L^0 \rightarrow \pi^+\pi^-)/(K_L^0 \rightarrow \text{all}) = 0.21\%$, we calculate the branching ratio to be $8.8^{+10.7}_{-5.5}\times10^{-9}$ (90% confidence level) for the $K_L^0 \rightarrow \mu^+\mu^-$ decay. (auth)

27360 DETERMINATION OF THE G PARITY AND ISOSPIN OF ψ (3095) BY STUDY OF MULTIPION DECAYS. Jean-Marie, B.; Abrams, G.S.; Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Chinowsky, W.; Feldman, G.J.; Friedberg, C.E.; Fryberger, D.; Goldhaber, G.; Hanson, G.; Hartill, D.L.; Kadyk, J.A.; Larsen, R.R.; Litke, A.M.; Lüke, D.; Lulu, B.A.; Lüth, V.; Lynch, H.L.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Pierre, F.M.; Pun, T.P.; Rapidis, P.; Richter, B.; Sadoulet, B.; Schwitters, R.F.; Tanenbaum, W.; Trilling, G.H.; Vannucci, F.; Whitaker, J.S.; Winkelmann, F.C.; Wiss, J.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 36: No. 6, 291-294 (9 Feb 1976).

We present here a measurement of six branching ratios of ψ (3095) corresponding to the decays ψ (3095) $\rightarrow \rho\pi$, $2(\pi^+\pi^-)$, $2(\pi^+\pi^-)1\pi^0$, $3(\pi^+\pi^-)$, $3(\pi^+\pi^-)$, $3(\pi^+\pi^-)1\pi^0$, and $4(\pi^+\pi^-)1\pi^0$. From this study, the isospin and G-parity quantum numbers are found to be $I^G=0^-$. (auth)

27361 RECENT RESULTS ON NEUTRINO, ANTINEUTRINO CHARGED CURRENT INTERACTIONS AT NAL. Aubert, B.; Benvenuti, A.; Cline, D.; Ford, W. T.; Imlay, R.; Ling, T. Y.; Mann, A. K.; Messing, F.; Piccioni, R. L.; Pilcher, J. (Harvard Univ., Boston, Mass. (USA); Pennsylvania Univ., Philadelphia (USA); Wisconsin Univ., Madison (USA); National Accelerator Lab., Batavia, Ill. (USA)). pp v.2 p.75-86 of High Energy Leptonic Interactions. Proceedings of the 9th Rencontre de Moriond. Meribel-les-Allues (France), March 3-15, 1974. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The dependence of the neutrino cross section of energy has been measured to 160 GeV. The ratio σ(antineutrino)/σ(neutrino) is measured up to 70 GeV. Preliminary results are presented for the distributions of the scaling variables x, y observed in neutrino induced events. (FR)

27362 MULTIPOLE ANALYSIS OF THE REACTION $\gamma p \rightarrow n\pi^+$ IN THE REGION OF THE $\Delta(1236)$ RESONANCE. Ganenko, V. B.; Krivets, A. G.; Miroshnichenko, I. I.; Nikiforov, V. I.; Sorokin, P. V.; Sanin, V. M.; Shalatskii, S. V. (Physical-Technical Inst., Kharkov). Yad. Fiz.; 22: No. 5, 1003-1007(Nov 1975). (In Russian)

An energy independent multipole analysis of the reaction $\gamma p \rightarrow n\pi^+$ is performed. The energy behavior of the obtained S and P wave amplitudes is in a satisfactory agreement with dispersion relation calculations. The $M_{1+}^{(3)}$ phase obtained from channel amplitudes coincides with the πN scattering phase which supports the T invariance of the $\gamma N \rightarrow N\pi$ process. (2 tables, 2 figures) (auth)

27363 PRODUCTION OF CHARMED PARTICLES IN NEUTRINO AND ANTINEUTRINO BEAMS. Gershtein, S. S.; Folomeshkin, V. N. (Inst. of High Energy Physics, Serpukhov, USSR). Yad. Fiz.; 22: No. 4, 787-791(Oct 1975). (In Russian)

Some simplest reactions of single and pair production of charmed and strange particles in neutrino and antineutrino beams are discussed. Cross sections of single production of charmed baryons in the mass range 2–5 GeV are presented. 2 figures. (auth)

27364 SIGMA BETA DECAY. Newman, D. E. Princeton, NJ; Princeton Univ. (1975). 96p. University Microfilms Order No. 76-1697.

Thesis (Ph. D.).

Describes an experiment to measure beta decays of the sigma particle. Sigmas produced by stopping a K^- beam in a liquid hydrogen target decayed in the following reactions: Kp yields SIGMA pi; SIGMA yields Ne nu. The electron and pion were detected by wire spark chambers in a magnetic spectrometer and by plastic scintillators, and were differentiated by a threshold gas Cherenkov counter. The neutron was detected by liquid scintillation counters. The data (n equals 3) shell electrons or the highly excited electrons decay first. Instead, it is suggested that when there are two to five electrons in highly excited states immediately after a heavy ion–atom collision the first transitions to occur will be among highly excited Rydberg states in a cascade down to the 4s, 4p, and 3d-subshells. If one of the long lived states becomes occupied by electrons promoted during the collision or by electrons falling from higher levels, it will not decay until after the valence shell decays. LMM rates calculated to test the methods used are compared to previous works. The mixing coefficients are given in terms of the states 4s4p, 45sp +-, and 5s5p. The applicability of Cooper, Fano, and Prats' discussion of the energies and transition rates of doubly excited states is considered. (Diss. Abstr. Int., B)

Strong (Baryon-induced)

Refer also to abstract 27518.

27365 (COO-3533-64(Vol. 1)) PROCEEDINGS OF THE IV INTERNATIONAL SYMPOSIUM ON NUCLEON-ANTINUCLEON INTERACTIONS, SYRACUSE, NEW YORK, MAY 2–4, 1975. Volume I. Chapters 1–4. Kalogeropoulos, T. E.; Wali, K. C. (eds.). (Syracuse Univ., N. Y. (USA). Dept. of Physics). 1975. 338p. (SU-4206-64(Vol. 1); CONF-750547-P1). Dep. NTIS $11.00.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

The conference contains 26 papers. Separate abstracts were prepared for 22 papers. Four papers appeared previously in NSA. For abstracts of these papers see CONF-750547. Eleven papers also appear in ERA. (JFP)

For abstracts of individual papers see: 27366–27384 and 27403–27405.

27366 (COO-3533-64(Vol.1), pp I.22-I.48) PROGRESS ON THE EXPERIMENT anti pD yields gamma + ANYTHING AT REST. Vayaki, A. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions, Volume I, Chapters 1–4, (Syracuse Univ., N. Y. (USA). Dept. of Physics).

The object of the experiment is to check the isotopic spin equalities that can be derived for anti pd reactions. It is concluded that the isotopic spin equalities are not satisfied, 20 percent eta production might explain the data, if eta is produced in multineutral channels, and direct gamma production is still an open question that is being investigated. (JFP)

27367 (COO-3533-64(Vol.1), pp I.49-I.52) ANTIPROTON–DEUTERON ANNIHILATIONS AT LOW ENERGIES. Tzanakos, G. (Syracuse Univ., NY). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions, Volume I, Chapters 1–4, (Syracuse Univ., N. Y. (USA). Dept. of Physics).

Antiproton annihilations in deuterium below 450 MeV/c, including at rest, in the 30'' bubble chamber are studied. There are 300^0K photographs containing 1.5×10^6 annihilations 60 percent of which occur above 260 MeV/c (in-flights) while most of the remaining occur at rest. Cross sections and branching ratios are discussed. (auth)

27368 (COO-3533-64(Vol.1), pp I.53-I.83) REPORT ON RESULTS ON anti np TOTAL CROSS SECTION AND anti pp CHARGE EXCHANGE DIFFERENTIAL CROSS SECTION. Gunderson, B. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions, Volume I, Chapters 1–4, (Syracuse Univ., N. Y. (USA). Dept. of Physics).

Two experiments are reported through which one attempts to circumvent the problem of rapid energy loss for the anti p which causes difficulty in accurately assessing the anti p momentum. For this purpose the anti np cross section is measured, also anti pp charge exchange differential cross sections and an anti np total cross section. The momentum range of 200 to 1000 MeV/c is covered. It is found that while the anti np total cross section rises at low momentum, the effect is not as strong as has been seen in anti pp. It is not clear if this is due to the problem of measuring very low anti p momenta, but there is other evidence to indicate a possible low lying resonance in anti pp. (JFP)

27369 (COO-3533-64(Vol.1), pp I.84-I.103) SEARCH FOR SUBSTRUCTURE IN anti pp TOTAL CROSS SECTION IN THE 2200 MeV MASS REGION. Peaslee, D. C. (Australian National Univ., Canberra); DeMarzo, C.; Guerriero, L. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions, Volume I, Chapters 1–4, (Syracuse Univ., N. Y. (USA). Dept. of Physics).

The anti pp total cross section is measured in an apparatus with a small target and high resolution beam in order to supplement previous work by looking for narrow structure that might be hidden in broad-mass bins. One could set limits on the partial widths of bosons coupling to the anti pp system. The product of an unknown production cross section and a partial width was determined. From the data the existence of resolution-sized structure above the smooth fit with the product of cross section and width greater than 7 MeV mb, it can be shown that a Breit–Wigner resonance of spin J coupled to the anti pp system in this region must have partial width GAMMA/sub anti pp/ less than $1.8/(2J+1)$ MeV. Also it is found that the broad enhancement observed in the anti pp total cross section persists without modification in an observation with mass resolution six times that of previous work. (JFP)

27370 (COO-3533-64(Vol.1), pp II.1-II.10) STRUCTURE IN THE ANTIPROTON–PROTON ELASTIC CROSS SECTION. Kalmus, P. I. P. (Queen Mary College, London). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions, Volume I, Chapters 1–4, (Syracuse Univ., N. Y. (USA). Dept. of Physics).

Differential and total cross sections for elastic anti pp scattering are measured. The energy range studied varied from 0.69 to 2.43 GeV/c. (JFP)

27371 (COO-3533-64(Vol.1), pp II.11–II.20) ANTIPROTON–PROTON ANNIHILATION INTO CHARGED PION AND KAON PAIRS. Kalmus, P. I. P. (Queen Mary College, London). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions, Volume I, Chapters 1–4, (Syracuse Univ., N. Y. (USA). Dept. of Physics).

Events of the type anti pp yields K^-K^+, pi^-pi^+ were studied at 0.79 to 2.43 GeV/c. Differential cross sections and Legendre coefficient ratios are shown. Resonances found as a result of model fitting showing spin–parity assignment versus mass squared are also shown. (JFP)

27372 (COO-3533-64(Vol.1), pp II.21–II.26) ANTI pp YIELDS $2pi^0$ (200–700) MeV/c. Dris, M. A. (Univ. of Pittsburgh). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions, Volume I, Chapters 1–4, (Syracuse Univ., N. Y. (USA). Dept. of Physics).

The annihilation mode anti pp yields $2pi^0$ for antiprotons reacting with liquid hydrogen and having momenta (200 to 700) MeV/c is examined. The angular distributions are forward peaked and the ratio $2pi^0/pi^+pi^-$ does not change appreciably from that at rest. (auth)

27373 (COO-3533-64(Vol.1), pp II.27–II.43) ANGULAR DISTRIBUTIONS FOR ANTI pp YIELDS pi^0pi^0 BETWEEN 1.2 AND 2.0 GeV/c. DeMarzo, C. (Bari Univ., Italy); Guerriero, L.; Posa, F. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Preliminary angular distributions are presented for anti pp yields pi^0pi^0 interactions at six laboratory momenta between 1.0 and 2.0 GeV/c. Integrated cross sections and Legendre coefficients are also shown. (JFP)

27374 (COO-3533-64(Vol.1), pp II.44-II.53) PRELIMINARY RESULTS FOR ANTI pp YIELDS pi^0eta^0 between 1.2 AND 2.0 GeV/c (ALSO ANTI pp YIELDS eta^0eta^0 AT TWO MOMENTS). DeMarzo, C. (Bari Univ., Italy); Guerriero, L.; Posa, F. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

The discussion of the preliminary results for anti pp yields pi^0eta^0, eta^0eta^0 includes the angular distribution, various total and differential cross sections, and the Legendre coefficients. (JFP)

27375 (COO-3533-64(Vol.1), pp III.1-III.12) INCLUSIVE PROPERTIES OF ANTI pd AT REST ANNIHILATION PRODUCTS. Roy, J. (Syracuse Univ., NY). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Various distributions are studied for the reactions anti pN yields pi + anything, anti pN yields K^0 + anything, and anti pd yields LAMBDA + anything at rest. The momentum distributions are particularly emphasized. (JFP)

27376 (COO-3533-64(Vol.1), pp III.13-III.45) PIONIC ANNIHILATIONS OF 0.40–0.92 GeV/c ANTIPROTONS ON NEUTRONS. Caro, D. E.; Gold, E.; Klein, A. G.; Opat, G. I.; Wignall, J. W. G. (Univ. of Melbourne, Victoria, Australia). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Research on anti pn annihilations in the anti p momentum range 0.40 to 0.92 GeV/c is summarized. Mostly annihilations into three and four pions are considered, but also some preliminary data on other pionic annihilation channels are considered. Included are cross sections and branching ratios, the reaction anti pn yields 2 pi^- pi^+, the reaction anti pn yields 3 pi^- pi^+pi^0, and G parity tests and rho – omega interference. (JFP)

27377 (COO-3533-64(Vol.1), pp III.47-III.58) PION MULTIPLICITIES FOR INTERMEDIATE ENERGY ANTI pp ANNIHILATIONS. Burns, R. R.; Condon, P. E.; Donahue, J.; Mandelkern, M. A.; Price, L. R.; Schultz, J.; Smith, D. W. (Univ. of California, Irvine). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Results for pion multiplicities and correlation coefficients near 1 GeV/c are reported for anti pp annihilations at 0.686 to 1.098 GeV/c. The topological cross sections and pion multiplicities and correlations are discussed. (JFP)

27378 (COO-3533-64(Vol.1), pp III.63-III.64) ANTI pp ANNIHILATION INTO 6 AND 7 PIONS BETWEEN 1.1 AND 1.4 GeV/c. Rosselet, P. (Lausanne-Neuchatel, Liverpool). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

The 6- and 7-pion anti pp annihilation at 1.1 and 1.4 GeV/c is characterized by a strong deformation of the pi^+ pi^- mass spectrum as compared to phase space, a strong angular correlation between pions in the reaction center of mass with the asymmetry coefficients given. The production of omega, eta, eta^1, and delta mesons is noted. (JFP)

27379 (COO-3533-64(Vol.1), pp III.68-III.87) MULTI-PION FINAL STATES IN THE T(2190) REGION. Handler, T. (Rutgers-the State Univ., New Brunswick, NJ); Jacques, P.; Jones, M. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Results of an analysis of four and five pion final states in anti pp interactions at 1.22 to 1.35 GeV/c are summarized. Included are resonance percentages, mass distributions, angular distributions, and polar equatorial asymmetries. (JFP)

27380 (COO-3533-64(Vol.1), pp III.88-III.98) EXPERIMENTAL STUDY OF THE PRODUCTION OF NEUTRAL PIONS IN ANTI pp ANNIHILATIONS AT 1.6 GeV/c. Fett, E. (Univ. of Bergen); Haatuft, A.; Olsen, J. M. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

The heavy liquid bubble chamber Gargamelle was used to study the rate of production of neutral pions in the pionic annihilation of 1.6-GeV/c antiprotons on free protons. Preliminary results are presented on the cross sections for most channels together with the mean pi^0 multiplicity and the first moments for annihilation into 0-prongs, 2-prongs, 4-prongs and 6-prongs. (auth)

27381 (COO-3533-64(Vol.1), pp III.99-III.114) PROCESS ANTI pp YIELDS 4 pi AT INTERMEDIATE ENERGIES. Mason, P. (Oliver Lodge Lab., Liverpool). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

In an attempt to identify annihilation mechanisms, the channel anti pp yields 2 pi^+ 2 pi^- at 2.5 and 4.6 GeV/c was studied. The main feature is the prolific production of rho, f, and g mesons. The effective mass and angular distributions are shown, and the masses and widths of the resonances are tabulated. Cluster properties are also discussed. (JFP)

27382 (COO-3533-64(Vol.1), pp III.115-III.131) CHARGED-PARTICLE MULTIPLICITIES IN 100 GeV/c ANTI pp INTERACTIONS. Whitmore, J. (Michigan State Univ., East Lansing); Morris, W.; Oh, B.Y. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Preliminary results are presented on the topological cross sections produced in antiproton-proton interactions from an exposure of the Fermilab 30-inch bubble chamber to a 100 GeV/c enriched anti p beam. The anti pp inelastic cross section is determined to be sigma/sub ine/ equals 34.65 +- 0.23 mb, and the average inelastic charged particle multiplicity is [n/sub c/] equals 6.74 +- 0.11. (auth)

27383 (COO-3533-64(Vol.1), pp IV.1-IV.8) STUDY OF DOUBLE SCATTERING EFFECT IN ANTIPROTON–DEUTERON ANNIHILATION. Zemany, P. D. (Michigan State Univ., East Lansing). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

The double scattering process in the deuteron is investigated for the reaction anti pd yields p/sub s/ + mesons. About 30 percent of the apparent anti pn annihilations are involved in double scattering. A model which describes the properties of protons emerging from apparent anti pn annihilations is presented. (auth)

27384 (COO-3533-64(Vol.1), pp IV.19-IV.23) DIFFRACTION DISSOCIATION IN THE REACTION ANTI pp YIELDS p ANTI p pi^+ pi^- AT 7.3 GeV/c^2. van Apeldoorn, G. W. (Zeeman Lab., Amsterdam); Harting, D.; Holthuizen, D. J.; Rijssenbeek, M. M. H. M.; Voetelink, C.; Warmerdam, J. M. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

An analysis of the reaction anti pp yields anti pp pi^+ pi^- at 7.3 GeV/c, assuming that the final state is mainly due to two diagrams, shows the appearance of two resonances at 1460 and 1700 MeV/c^2. Assuming that all selected events are produced by diffraction dissociation, the cross section for diffraction dissociation of p or anti p in the anti pp pi^+ pi^- final state is 1.2 mb compared with a total cross section for this final state of 3.0 mb. (JFP)

27385 (COO-3533-64(Vol.2), pp VI.10-VI.16) NUCLEAR ABSORPTION OF SLOW ANTIPROTONS. Condo, G. T. (Univ. of Tennessee, Knoxville); Bugg, W. M.; Hart, E. L.; Cohn, H. O.; McCulloch, R. D. 1975.

From fourth international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5-8. (Syracuse Univ., N. Y. (USA). Dept. of Physics).

Because of the existence of the Y_0^* the K^-p threshold, the analysis of slow K^- absorption is difficult. This experiment using anti p absorptions is an attempt to obviate this difficulty. The ratio of anti pn to anti pp absorption for the four elements used in the experiment, which are carbon, titanium, tantalum, and lead, is measured. (JFP)

27386 (COO-3533-64(Vol.2), pp VII.1-VII.41) ANTI p AND ANTI n FACILITIES AT THE BNL AGS. Lowenstein, D. I. (Brookhaven National Lab., Upton, NY). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5-8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

The typical AGS operating conditions are outlined. The status and availability of beams at the end of FY 75 and a brief synopsis of the experiments that have gotten beam time during the present year are given. New experiments in FY 76 that will be using anti p beams are also outlined. (CES)

27387 (COO-3533-64(Vol.2), pp VII.42-VII.66) ANTIPROTON PHYSICS AT FERMILAB: A REVIEW. Lach, J. (Fermi National Accelerator Lab., Batavia, IL). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5-8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Some of the things that were learned about antinucleons, some of the experiments now on the floor, and some longer-range experiments and possibilities for probing antinucleon reactions are summarized. (JFP)

27388 (COO-3533-64(Vol.2), pp VIII.124-VIII.135) INTERPRETATION OF A NARROW RESONANCE AT 1932 MeV. Weingarten, D.; Okubo, S. (Univ. of Rochester, NY). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5-8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Recent work concerning a narrow enhancement observed in anti pp and anti pd total cross sections is described. Included are the spin and coupling constants, anti NN and SU(3), and duality. (JFP)

27389 (CRN-HE-75-11) PRELIMINARY RESULTS ON LOW MULTIPLICITY pd AND π^+ d INTERACTIONS AT 200 GeV/c. Braun, H.; Brick, D.; Etienne, F.; Fridman, A.; Gerber, J. P.; Juillot, P.; Maurer, G.; Michalon-Mentzer, M. E.; Eisenberg, Y.; Haber, B. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 13p. INIS.

From 1975 high energh particle physics conference; Palermo, Italy (23 Jun 1975).

Presentation is made of preliminary results on the low multiplicity events obtained from π^+ d and pd interactions at 200 GeV/c. The data came from a 50,000 photograph exposure carried out at the Fermilab with the 30 inch deuterium filled bubble chamber and the proportional wire hybrid system. (FR)

27390 (CRN-HE-75-12) COHERENT PRODUCTION FEATURES IN dp INTERACTIONS AT 11.9 GeV/c. Braun, H.; Brick, D.; Fridman, A.; Gerber, J. P.; Juillot, P.; Maurer, G.; Alexander, G.; Dagan, S.; Grunhaus, J.; Levy, A. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 12p. INIS.

From 1975 high energy particle physics conference; Palermo, Italy (23 Jun 1975).

The two pion production in coherent dp reactions is studied. The resonance production as well as the d^* effect and the fragmentation processes are discussed. The present results are compared with available coherent $\bar{p}$ d data. (FR)

27391 (INIS-mf-1866) BARYON-BARYON SCATTERING IN A ONE-BOSON-EXCHANGE POTENTIAL MODEL. Nagels, M. M. (Katholieke Universiteit Nijmegen (Netherlands)). 20 Mar 1975. 212p. INIS.

96 refs., 59 tables, 20 figs.

The NN reactions pp → pp, pn → pn and the YN reactions $\Sigma^+p \to \Sigma^+p$, (Ap, Σ^+n, Σ^0p), An → An and $\Sigma^-p \to (\Sigma^-p, \Sigma^0n, \Lambda n)$ at $T_{lab} \leq 350$ MeV are all described by an ϵBEP model with a phenomenological hard core potential for $r \leq 0.5$ fm. The local potentials for $r \geq 0.5$ fm are deduced from the exchange of mesons from pseudoscalar and vector meson SU(3) nonets and the scalar ϵ meson, assuming this is an SU(3) singlet. The free parameters in the model, eight coupling constants, four hard core parameters in NN, and two F/(F + D) ratios plus three hard core parameters in YN are determined by an χ^2 fit to experimental data. Those data are total and differential elastic and inelastic cross sections, polarization data, low energy scattering lengths and deuteron parameters. The general agreement is good except for some discrepancies at higher energy. The cusp at the Σ^+n production threshold in the Ap → Ap total cross section is explained and a big phase shift in the $^1P_1$ (Σ^+p) wave at higher energies is predicted. (INIS)

27392 (LPC-75-03) ANTIPROTON CROSS SECTIONS IN A CONTINUUM OF ENERGY. Laloum, M. (College de France, 75-Paris. Lab. de Physique Atomique et Moleculaire). 1975. 7p. INIS.

A simple and quite accurate method allowing a continuous energy-dependent normalization of antiproton cross sections, down to the immediate vicinity of stop-point is proposed. (FR)

27393 PRODUCTION OF MUON PAIRS BY 150-GeV/c π^+ AND PROTONS. Anderson, K.J.; Henry, G.G.; McDonald, K.T.; Pilcher, J.E.; Rosenberg, E.I. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637); Branson, J.G.; Sanders, G.H.; Smith, A.J.S.; Thaler, J.J. Phys. Rev. Lett. 36: No. 5, 237-240 (2 Feb 1976).

We have measured the cross section for $\mu^+\mu^-$ production in the reactions $(\pi^+,p)+Be \to \mu^+\mu^- + X$, at an incident momentum of 150 GeV/c. This Letter covers the pairs with masses above 2 GeV/c^2, in which region the signal is dominated by production of the J (3.1). No events with μ-pair mass >4.1 GeV/c^2 were seen, although the experiment is sensitive up to ≥12 GeV/c^2. (auth)

27394 RAPIDITY INTERVALS OF SECONDARY CHARGED PARTICLES PRODUCED IN pp COLLISIONS AT 200 GeV/c. Adamovich, M. I.; Dobrotin, N. A.; Larionova, V. G.; Tret'akova, M. I.; Kharlamov, S. P.; Chernyavskii, M. M. (Inst. of Physics, Moscow). Yad. Fiz.; 22: No. 3, 530-538(Sep 1975). (In Russian).

Experimental distributions are presented for rapidity intervals Δ_{kn}, containing (k + 1) particles in a shower of multiplicity n, generated in inelastic pp collisions at 200 GeV/c. Statistics of the rapidity intervals Δ_{kn} is considered in a simple multiperipheral model. It is shown that at small multiplicities correlations of neighbor particles in rapidity are observed. At high multiplicities many-particle correlations are observed. A similar effect is observed also in the central region of the rapidities. The experimental dependence of the cross section $d\sigma/d\Delta_{max}$ on the maximal interval between the neighbor particles was compared with the theoretical prediction based on account of reggeon and pomeron exchanges. The maximum of the experimental distribution is shifted toward small values of Δ_{max}. (auth)

27395 SEARCH FOR NEW HEAVY PARTICLES IN COLLISIONS OF 70 GeV PROTONS WITH NUCLEI. Baldin, B. Yu.; Vertogradov, L. S.; Vishnevskii, N. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 3, 512-519(Sep 1975). (In Russian).

The search for new heavy particles with the charge $0.5 \leq |Z| < 3$ is made in the (2.2 to 10) M_p mass region. The experiment is carried out in the beam of negative particles with an effective momentum of 25 GeV/c, produced by 70-GeV protons at zero angle on the internal target of the Serpukhov synchrotron. Amongst $3.75 \cdot 10^{11}$ particles of the beam no one particle with its mass in the region of interest was found, except four ^3H nuclei. The upper limit estimation of the production cross section of new heavy particles is calculated to be $(d^2\sigma/dp\,d\Omega)$ (0°, 25 GeV/c) $\leq 2{,}6 \cdot 10^{-36}$ (cm²/sr · GeV/c · Al nucleus. (auth)

27396 ASSOCIATIVE MULTIPLICITIES IN π^-C INTERACTIONS AT pc = 40 GeV WITH BACKWARD EMISSION OF PROTONS IN THE LABORATORY SYSTEM. Azimov, S. A.; Grishin, V. G.; Inogamov, T. Ya. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 4, 750-753(Oct 1975). (In Russian)

Associative multiplicities have been investigated for the reaction $\pi^- + {}^{12}C \to p$ (backward in l.s.) + X at 40 GeV/c. The analysis shows that marked correlations are not observed between protons emitted into backward and forward hemispheres in the lab. coordinate system. The multiplicity of relativistic charged particles does not depend on the properties of protons emitted backward in the laboratory system. 1 table, 4 figures. (auth)

27397 INTERACTION OF 200 GeV/c PROTONS WITH EMULSION NUCLEI MULTIPLICITIES OF CHARGED PARTICLES.

Alma Ata–Leningrad–Moscow–Tashkent, USSR. Yad. Fiz.; 22: No. 4, 736-749(Oct 1975). (In Russian)

The experimental data are presented and analyzed on multiplicity distribution and correlations of various types of secondary particles from proton-nuclear interactions in the emulsion at 200 GeV/c. Characteristics of strongly ionizing particles (the mean multiplicities $\langle n_b \rangle$, $\langle n_g \rangle$ and $\langle N_h \rangle$, their distributions and correlations) are energy independent (or show a weak energy dependence) in the 20–200 GeV/c range. The data contradict the cascade evaporation model and qualitatively agree with the mechanism of particle production via comparatively long-lived intermediate states. The obtained A dependence ($\sim A^{0.19}$) of the distributions of relativistic particles is consistent with the Monte-Carlo calculations by a simple two-stage model. Those distributions satisfy the KNO scaling in the 67–200 GeV/c range, but the shape of the universal curve $\psi(n_s/\langle n_s \rangle)$ shows a weak A dependence. 9 figures, 4 tables. (auth)

27398 MULTIPLICITY OF RELATIVISTIC AND SLOW CHARGED PARTICLES IN INELASTIC HADRON INTERACTIONS AT p = 17 TO 67 GeV/c. Kozodaeva, O. M.; Maslennikova, N. V.; Orlova, G. I.; Tret'yakova, M. I.; Chernyavskii, M. M. (Lebedev Inst. of Physics, Moscow). Yad. Fiz.; 22: No. 4, 730-735(Oct 1975). (In Russian)

Results are presented on analysis of interactions of protons and pions on photoemulsion nuclei in the momentum range 17–67 GeV/c. The interactions are separated into classes: quasinucleon, light (with nuclei C, N, O) and heavy (with nuclei Ag, Br). For all the classes the distributions are obtained in n_s, n_g, and n_b as well as dependences of $\langle n_s \rangle$, $\langle N_h \rangle$ and R on energy of the primary particle. The experimental data cannot be totally described by the cascade models. 1 table, 5 figures. (auth)

27399 SEARCH FOR DELAYED HIGH ENERGY RADIATION PRODUCED BY A LEAD TARGET IRRADIATED BY 45 GeV PROTONS. Alekseev, G. D.; Zaitsev, A. M.; Kalinina, N. A. (Joint Inst. of Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 5, 1021-1025(Nov 1975). (In Russian)

A search is carried out for the γ quantum or electron delayed radiation which could arise in the decay of hypothetical long-lived particles produced in collisions of 45 GeV protons with lead nuclei. The life-time region from 0.1 sec to twenty-four hours is studied. The delayed radiation effect has not been found. The upper limit of the production cross section of a quasiradioactive nucleus is obtained to be of the order of 10^{-34} cm^2 per Pb nucleus. (2 figures, 1 table) (auth)

27400 PROTON–PROTON TWO PRONG EVENTS AT 102 GeV/c. Green, N. E. Ann Arbor, MI; Univ. of Michigan (1975). 144p. University Microfilms Order No. 75-29,230.

Thesis (Ph. D.).

A report is given on proton-proton scattering reactions having only two charged resultants where the laboratory beam momentum is 102 GeV/c. Events with two charged secondary tracks or prongs are of two types: elastic (pp yields pp) and inelastic (pp yields ABX where X is one or more neutral particles). In particular it is necessary to identify elastic scattering events and segregate them in order to study the inelastic components. An attempt is made to perform this separation more accurately than previously reported. Further this is a comparison of the Michigan Polly automatic scanning–measuring system with manual digitization procedures and results. It is also an evaluation of the Polly hardware and software performance to date. (Diss. Abstr. Int., B)

27401 PERIPHERAL PRODUCTION OF NUCLEON-ANTINUCLEON PAIRS IN pi p SCATTERING AT 13 GeV/c. Delude, R. S. Lafayette, IN; Purdue Univ. (1975). 241p. University Microfilms Order No. 76-517.

Thesis (Ph. D.).

A study was made of peripherally produced nucleon-antinucleon pairs in the reactions pi^+p yields (p anti n)p, pi^-p yields (anti pn)p, and pi^+p yields (p anti p) DELTA^{++}. The cross section for these reactions was determined to be 25.9 +– 1.6 mu b for pi^+p yields (p anti n)p in the range $-t(pp)$ less than or equal to .5 (GeV/c)^2 and M(anti p n) less than or equal to 2.7 GeV, 29.1 +– 2.4 mu b for pi^-p yields (anti p n)p in the range $-t(pp)$ less than or equal to .5 (GeV/c)^2 and M(anti p n) less than or equal to 2.7 GeV, and 3.7 +– .3 mu b for pi^+p yields (p anti p) DELTA^{++} in the range $-t'$(p DELTA) less than or equal to .75 (GeV/c)^2. In all three reactions studied the nucleon-antinucleon invariant mass, M(N anti N), shows a broad enhancement lying just above threshold. An analysis of the angular distributions of the N anti N pairs is presented which shows a rapid variation with the M(N anti N) mass suggesting the presence of several spins. These angular distributions are compared with those for the reactions pi^-p yields (p anti p)n and anti pp yields pi^+pi^- in which a similar broad enhancement in the M(N anti N) was observed. An attempt was made to describe the pi^+p yields (p anti n)p and pi^-p yields (anti p n)p data in terms of one-pion exchange models. The reaction pi^+p yields (p anti p) DELTA^{++} seems to be dominated by M1 rho-exchange. Evidence for the presence of at least two different spin states for the (p anti p) pair of this reaction is presented. Finally, a study of antinucleon-nucleon scattering was made using the secondary anti NN interactions found in this data. Topological comparisons are made between the anti np and anti pp data samples. The annihilation subsamples of these events exhibit nonperipheral scattering characteristics and show the presence of copious resonance production. (Diss. Abstr. Int., B)

Strong (Meson-induced)

27402 (COO–2197-34) PION–NUCLEON INTERACTION AND MESONIC ATOMS. Progress Report, 1 February 1975–31 January 1976. Rebka, G. A. Jr.; Kunselman, R. (Wyoming Univ., Laramie (USA)). 1976. Contract E(11-1)-2197. 18p. Dep. NTIS $3.50.

Research on pion–nucleon interactions and mesonic atoms is summarized. (JFP)

27403 (COO-3533-64(Vol.1), pp I.1-I.20) NARROW RESONANCES OF HIGH MASS IN PARTICLE-ANTI PARTICLE MODE. Becker, U. (Massachusetts Inst. of Tech., Cambridge). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N. Y. (USA). Dept. of Physics).

A review is given of high mass narrow resonances in the particle–antiparticle mode. Included are a discussion of the particle properties, the detection apparatus at Brookhaven, the first measurements, and the discovery of the new particles. (JFP)

27404 (COO-3533-64(Vol.1), pp I.05-I.115) RECENT SEARCH FOR MONOENERGETIC gamma-RAYS FROM psi(3684) DECAY. Simpson, J. W. (Stanford Univ., CA); Beron, B. L.; Hilger, E. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N. Y. (USA). Dept. of Physics).

The results of a search for monoenergetic gamma rays having energies above 50 MeV arising from psi(3684) decay are reported. No evidence was found for monoenergetic gamma-ray emission from psi(3695) decay, and upper limits are placed on such emissions for energies above 50 MeV. Specifically no evidence was found for the strong radiative transitions to the 2^3P bound states anticipated in the simple charmonium model. In addition, since the psi(3695) is known to decay into the psi(3105) with a branching ratio of about 57 percent, upper limits are also placed on monoenergetic gamma-ray emission from psi(3095) decay that are approximately twice as large as those shown. (JFP)

27405 (COO-3533-64(Vol.1), pp III.60-III.61) POSSIBLE S(1930) ENHANCEMENT IN ANTI pp YIELDS ANTI nn pi NEAR THRESHOLD. Burns, R. R.; Condon, P. E.; Donahue, J.; Mandelkern, M. A.; Michelotti, L.; Price, L. R.; Schultz, J. (Univ. of California, Irvine). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume I. Chapters 1–4. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

Proton–antiproton interactions at 0.943 to 1.098 GeV/c were studied in the final states anti pp pi^0, anti pn pi^0, anti np pi^-. The main concern is to obtain results for comparison with current algebra predictions for soft pion emission. The invariant-mass plots are discussed. An enhancement is found which may be due to the S(1930). The limited statistics suggest the enhancement to be in I equals 1. (JFP)

27406 (COO-3533-64(Vol. 2), pp 1-16) DECAY INTO STRANGE BARYON-ANTIBARYON PAIRS AND AN I SPIN DETERMINATION OF THE PSI(3095). Goldhaber, G. (Univ. of California, Berkeley); Johnson, A. D.; Kadyk, J. A. 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5–8. (Syracuse Univ., N. Y. (USA). Dept. of Physics).

Data are given for PSI(3095) decay into LAMBDA anti LAMBDA, and evidence is shown for the channels SIGMA anti SIGMA and

possibly XI anti XI. The final states SIGMA anti SIGMA and XI anti XI are however ambiguous with LAMBDA anti LAMBDA X^0. The decay PSI(3095) yields LAMBDA anti LAMBDA is of particular interest because LAMBDA anti LAMBDA pair is in a pure I equals 0 state. It is shown that this decay proceeds directly rather than through an intermediate gamma, and thus one obtains a determination of the I-spin of the PSI(3095). (JFP)

27407 (COO-3533-64(Vol.2), pp V.42-V.65) HYPERCHARGE ANNIHILATION. Mason, P. (Oliver Lodge Lab., Liverpool). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5-8. (Syracuse Univ., N. Y. (USA). Dept. of Physics).

Aspects of the process K^-p yields LAMBDA + pions for K^- mesons of momentum 8.25 GeV/c are examined. It is shown that the hypercharge annihilation process can be effectively separated into off-shell baryon (anti BB) and strangeness (anti KK) annihilation. Both annihilation regions have many features in common and show strong similarities to on-shell annihilation processes; some differences are also noted. (auth)

27408 SEARCH FOR CHARMED MESONS AND BARYONS. Hagopian, V.; Wilkins, D.P.; Wind, B.; Hagopian, S.; Albright, J.R.; Lannutti, J.E.; Pewitt, N.D.; Horne, C.P. (Department of Physics, Florida State University, Tallahassee, Florida 32306); Bensinger, J.R. Phys. Rev. Lett. 36: No. 6, 296-300 (9 Feb 1976).

Data from a 15-GeV/c π^+d experiment have been used to search for both short- and long-lived narrow resonances. No statistically significant high-mass narrow resonance has been observed up to a mass of 5 GeV. There is a single long-lived V that remains unexplained. Cross-section limits (95% confidence level) of 0.7 μb for the long-lived possibility and 2 to 4 μb for the short-lived possibilities have been obtained. (auth)

27409 MULTIPLICITY DISTRIBUTIONS IN 20 GeV/c π^-p INTERACTIONS. Balea, E.; Coca, C. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 20: No. 8, 823-829(1975).

Multiplicity distributions are presented for charged, as well as strange, neutral particles produced in π^-p interactions at 20 GeV/c. Parameters characterizing the behavior of the multiplicity distributions namely, $\langle n \rangle$, D, $\langle n \rangle/D$, f_2 and normalized moments are given and compared with similar values from other experiments. The multiplicity distributions obtained cannot be described by single functions in the KNO variables. (auth)

27410 MULTIPLICITY OF SECONDARY PARTICLES PRODUCED IN DIFFRACTIVE AND NONDIFFRACTIVE π^-p INTERACTIONS. Grishin, V. G.; Kerachev, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 3, 579-582(Sep 1975). (In Russian).

Multiplicity distributions of π^0 mesons and of all secondary particles produced in diffractive and nondiffractive π^-p interactions at p = 40 GeV/c are obtained. Comparison of the obtained experimental results with data at other energies shows that the multiplicity scaling is valid for all secondary particles. (auth)

27411 $\pi^{-12}C$ INTERACTIONS AT E_π = 40 GeV AND HADRON CLUSTER HYPOTHESIS. Inogamova, T. Ya.; Kalinkin, B. N.; Lyubimov, V. B.; Tuvdendorzh, D.; Shmonin, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 3, 563-567(Sep 1975). (In Russian).

The analysis of some characteristics of the interaction of π mesons with ^{12}C nucleus at pc = 40 GeV (distributions of fast and slow particle multiplicity, correlations between them, etc.) is presented. The obtained results are in good agreement with the hypothesis of intermediate cluster state realization. (auth)

27412 π-MESON INTERACTIONS AT p = 17 GeV/c ON LIGHT AND HEAVY NUCLEI. Maslennikova, N. V.; Tret'yakova, M. I. (Lebedev Inst. of Physics, Moscow). Yad. Fiz.; 22: No. 4, 687-691(Oct 1975). (In Russian)

Interactions obtained in nuclear photoemulsion exposed to 17 GeV/c π^- mesons in magnetic field are analyzed. The events are separated in the interactions with nucleons, light (C, N, O) and heavy (Ag, Br) nuclei. The average multiplicities, as well as the correlations between them, do not agree with the predictions of the cascade model. Data on angular and energy distributions of the secondary particles are also presented. The average inelasticity coefficients K_{π^0},K^0 coincide up to the errors for these three groups. 4 tables, 4 figures. (auth)

27413 SPIN OF THE X^0(958) MESON FROM THE REACTION $\pi^-p \to X^0n \to (\gamma\gamma)n$. Lednitski, R.; Shafranov, M. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 4, 837-841(Oct 1975). (In Russian)

It is shown that the problem of the X^0 (958)-meson spin may be solved unambigously investigating the Adair distributions for the reaction $\pi^-p \to X^0n \to (\gamma\gamma)n$ in a large interval of the angles, including very asymmetric decays $X^0 \to \gamma\gamma$. For example, for a photon detector with the aperture angle of about 20° one needs the π^--meson beam with the momentum of about 30 GeV/c to register the sufficiently asymmetric decays. In case the beam intensity is 10^6 π^-/cycle, the accelerator time of about 10 days is necessary. 1 table, 3 figures. (auth)

27414 $\pi^{-12}C$ INTERACTION AT p = 40 GeV/c WITH BACKWARD EMISSION OF PROTONS IN THE LAB SYSTEM. Bucharest-Dubna-Moscow-Sofia-Tashkent-Tbilisi-Ulan Bator Collaboration. Yad. Fiz.; 22: No. 5, 1026-1030(Nov 1975). (In Russian)

The interactions of π^--mesons with carbon, accompanied by protons emitted backward in the l.s., have been studied by means of the 2 m propane bubble chamber exposed to 40 GeV/c π^--mesons. The structure function obtained for these protons does not contradict the concepts of its universality relative to the change of the type of incident particles and their energy. (5 tables, 2 figures) (auth)

27415 POLARIZATION OF HYPERONS IN π^-p INTERACTIONS AT 5 GeV/c. Glagolev, V. V.; Kuznetsov, A. A.; Pestova, G. D.; Sabeu, M. (Joint Inst. of Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 5, 1008-1013(Nov 1975). (In Russian)

Results of studying the polarization of hyperons in inclusive processes of the kind $\pi^- + p \to Y$ + everything in π^-p interactions at p_{π^-} = 5 GeV/c are presented. (3 figures, 5 tables)

27416 EXPERIMENTAL STUDY OF SCALING IN PROTON AND K^+ MESON FRAGMENTATION REGIONS AND IN CENTRAL REGIONS IN THE REACTION $K^+p \to \pi^- + X$ AT 32 GeV/c. Windmolders, R.; Vorobev, A. P.; Henri, V. P. Yad. Fiz.; 22: No. 5, 1014-1020(Nov 1975). (In Russian)

New data are presented on inclusive single particle distributions for reaction $K^+p \to \pi^- + X$ at 32 GeV/c. The comparison with lower energy experiments shows early scaling in the proton $p \xrightarrow{K^+} \pi^-$ and kaon $K^+ \xrightarrow{p} \pi^-$ fragmentation regions. The approach to scaling in the central region and the shapes of inclusive spectra are consistent with dependences as formulated in the Mueller-Regge phenomenology. (6 figures) (auth)

27417 ANALYSIS OF NEUTRAL FINAL STATES IN π^-p COLLISIONS IN THE INVARIANT MASS REGION ABOVE 2 GeV AT 40 GeV/c MOMENTUM. Apel, W. D. (Inst. of High Energy Physics, Serpukhov, USSR); Augenstein, K.; Bertolucci, E. Yad. Fiz.; 22: No. 5, 1031-1034(Nov 1975). (In Russian)

The invariant mass spectra of final states in π^-p collisions at π^- momentum of 40 GeV/c were studied in order to search for new heavy particles. At about 10^{-34} cm^2 cross sections there have been found no particles with their masses of 2-5 GeV decaying into γ quanta, π^0, η^0 and X^0 mesons. (2 figures, 1 table) (auth)

27418 K^+ yields $K^+ pi^+ pi^- p$ AT 6.8 GeV/c WITH PRISM PLOT ANALYSIS. Felock, D. H. Baltimore; Johns Hopkins Univ. (1975). 166p. University Microfilms Order No. 76-1513. Thesis (Ph. D.).

The "prism plot technique" of separating production channels is studied with the four-body final state 6.8 GeV/c K^+p yields $K^+ pi^+ pi^- p$ and the quasi-three body final state K^+p yields $K^*(890)$ pi^+p. A computer program using an operator-controlled display scope to separate clusters of events is shown to make an incomplete separation from background of such strong channels as $K^*(890)$ $DELTA^{++}$. Kinematics in the prism plot space are developed and shown to lead to clustering of events from particular production channels. However, these channels are shown to overlap in the prism plot space and a Monte Carlo version of the prism plot technique is shown to result in random assignments of events in the overlap regions. That is, the Monte Carlo version is shown to be a fit of a production model to the experimental data. The reaction 6.8 GeV/c K^+p yields $K^+ pi^+ pi^- p$ is studied, and evidence for the reaction K^+p yields $K^*(1660)p$ yields K^+rho p yields $K^+ pi^+ pi^- p$ is presented. The cross sections for 6.8 GeV/c K^+p yields $K^+ pi^+ pi^- p$ and K^+p yields $K^*(890)$ $DELTA^{++}$ are shown to be 1.47 +- 0.07 mbarn and 276 +- 17 mu barn, respectively. These values are in good agreement with energy-dependent fits to the cross sections from other experiments. (Diss. Abstr. Int., B)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 27347-27352, 27545, and 27900.

27419 (CNRS-CPT-74-P-639, pp 58-67) QUARKS AND GAUGE FIELDS. 't Hooft, G. (CERN, Geneva). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

Quark confinement in four space-time dimensions can be obtained in a simple model described by a local but not renormalizable Lagrangian. The interactions can be made such that the electric components of a gauge field are squeezed into vortex lines so that there are stringlike forces between quarks. The Lagrangian can perhaps be looked upon as an "effective" Lagrangian of the real world, and the model may give some insight in the dynamics of quark confinement. (auth)

27420 (CNRS-CPT-74-P-639, pp 125-147) QUARK CONFINEMENT. Wilson, K. G. (Cornell Univ., Ithaca, NY). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

A model of confined quarks is presented. It involves an abelian (or nonabelian) gauge field coupled to a quark field. The theory is quantized on a discrete space-time lattice. It shows quark confinement for strong coupling. Specifically, for strong coupling isolated quarks have infinite mass and quark-antiquark pairs with a large separation r have an energy proportional to r. The theory has local gauge invariance as an exact symmetry in strong coupling. The strong coupling theory is far from covariant due to the lattice. (auth)

27421 (CNRS-CPT-75-P-729) THREE PARTICLE POINCARE STATES AND SU(6) × SU(3) AS A CLASSIFICATION GROUP FOR BARYONS. Buccella, F.; Sciarrino, A.; Sorba, P. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique). May 1975. 39p. INIS.

A complete set of democratic quantum numbers is introduced to classify the states of an irreducible unitary representation (IUR) of the Poincare group obtained from the decomposition of the direct products of three I.U.R. Such states are identified with the baryon states constituted of three free relativistic quarks. The transformation from current to constituent quarks is then easily reobtained. Moreover, the group SU(6) × SU(3) appears naturally as a collinear classification group for baryons. Results similar to those of the symmetric harmonic oscillator quark model are obtained. (FR)

27422 THE NATURE OF ELEMENTARY PARTICLES. Heisenberg, W. Phys. Today 29: No. 3, 32-40 (Mar 1976).

Because particle number is not conserved in high-energy interactions it may be meaningless to ask about the constituent parts of elementary particles; perhaps the central problem is dynamics. (auth)

27423 INTRODUCTION TO ELEMENTARY PARTICLE THEORY. Novozhilov, Yu. V. International Series of Monographs in Natural Philosophy. Volume 78. Oxford; Pergamon Press (1975). 398p. $35.00.

Translated by J. L. Rosner.

A thorough text on elementary particle theory is presented. It is assumed that the reader is familiar with nonrelativistic quantum mechanics, classical relativity theory, and group theory. It is also of advantage to be acquainted with Lagrangian field theory and Feynman diagrams. Part I gives a basic description of elementary particles; part II considers questions of relativistic quantum mechanics and kinematics. In part III, the problem of internal symmetry is discussed and part IV is devoted to new dynamical approaches likely to have the greatest influence on the development of future theory. (SDF)

27424 TIME DECAY FOR FERMION SYSTEMS WITH PERSISTENT VACUUM. Davies, E. B.; Eckmann, J. P. (Univ., Geneva). Helv. Phys. Acta; 48: 731-742(1975).

The relaxation to equilibrium of a system coupled to an infinite fermion reservoir at zero temperature is considered. In the weak coupling limit, an exponential decay law is obtained for the system. In contrast to earlier solutions of such problems, certain self-interactions of the particles of the reservoir are allowed which do not polarize the vacuum but which may influence the exponential decay law. (auth)

27425 CLASSIFICATION OF MODEL PREDICTIONS ON SYMPTOTIC BEHAVIOR OF MULTIPLICITY MOMENTS. Berceanu, S. (Joint Inst. for Nuclear Research, Dubna, USSR). Rev. Roum. Phys.; 20: No. 8, 831-838(1975).

A method to classify the behavior of average multiplicity and higher moments at high energy is presented. Supposing various unbounded asymptotical behaviors for the generating multiplicity function, prediction of different models on average multiplicity can be reproduced. (auth)

27426 NEUTRAL CURRENT EFFECTS IN AN SU(3) × U(1) GAUGE MODEL. Maharana, K.; Sastry, C. V. (Regional Engineering Coll., Orissa, India). Pramana; 6: No. 1, 34-41(Jan 1976).

The anomalous magnetic moment of muon is calculated in an SU(3) × U(1) gauge model proposed by Gupta and Mani. We find the contribution due to the intermediate gauge bosons to be of the same order of magnitude as in Weinberg-Salam model. The deep-inelastic structure functions are also analyzed in the same model and inequalities for the structure functions are obtained in the light-cone algebra approach. (auth)

27427 ENERGY BEHAVIOR OF INCLUSIVE SPECTRA IN MULTIPERIPHERAL MODEL AND CLUSTERS. Dremin, I. M.; Dunaevskii, A. M. (Lebedev Inst. of Physics, Moscow). Yad. Fiz.; 22: No. 3, 568-578(Sep 1975). (In Russian).

Using the multiperipheral equation for the inclusive spectra it is shown that the experimentally observed energy behavior of inclusive spectra in the pionization region, as well as in the fragmentation region, may be described if cluster production is possible in blocks of the multiperipheral graph. Two different models of the clusters are investigated: those having the "plateau" spectrum, expanding as logarithm of the energy, and the statistical clusters. The problem of rapid scaling is explained as a consequence of partial cancellation of contributions from diagrams with production of resonances and clusters. (auth)

27428 PRODUCTION OF HADRONS WITH HIGH TRANSVERSE MOMENTA IN THE FRAGMENTATION REGION. Shoykhet, V. Kh. (Tbilisi State Univ., USSR). Yad. Fiz.; 22: No. 3, 549-562(Sep 1975). (In Russian).

The inclusive cross section (ICS) of production of a high transverse momentum hadron in the fragmentation region is calculated in the multiperipheral model (MPM) and in the covariant parton model (CPM). The ICS is calculated in the region $2m/(s)^{1/2} \ll 2p_\perp/(s)^{1/2} \ll 1 - 2|p|/(s)^{1/2} \ll 1$ where $|p|$ is the hadron 3-momentum, $p_\perp$ is the hadron transverse momentum, $(s)^{1/2}$ is the energy of colliding particles. It is shown that in that region the ICS can be factorized: $f = (p_\perp)^{-8} F(z)$, where F is expanded in powers of a small parameter $1 - z$ ($z = 2|p|/(s)^{1/2}$). It is mentioned that F(z) are essentially different in the MPM and CPM, therefore experimental investigation of the ICS z dependence can help to choose a correct mechanism from the two models of production of hadrons with high transverse momenta. (auth)

27429 ANALYTICAL PROPERTIES OF DIFFERENTIAL CROSS SECTION OF INELASTIC PROCESS. Rcheulishvili, G. L.; Samokhin, A. P. Teor. Mat. Fiz.; 25: No. 3, 425-429 (Dec 1975). (In Russian)

Analyticity regions of the differential cross section $d^2\sigma/d\cos\theta d\varphi$ and the function Φ (see (2)) with respect to $\cos\theta$ at physical values of φ are found for the process $a + b \to c + d + f$ in the approximation of pole diagrams. At all energies above the threshold and $0 \le \varphi \le 2\pi$ for $d^2\sigma/d\cos\theta d\varphi$ ($\varphi \ne 0, \pi, 2\pi$ for Φ) these regions include fixed neighborhoods of physical values of $\cos\theta$. (auth)

27430 FORMAL ASPECTS OF THE MELOSH AND GENERALIZED UNITARY TRANSFORMATIONS OF A CLASS OF MASSIVE-PARTICLE WAVE EQUATIONS. Weaver, D. L. (Tufts Univ., Medford, MA). Phys. Rev., D; 12: No. 8, 2325-2329(15 Oct 1975).

The Melosh, Foldy-Wouthuysen, Cini-Touschek, and Majorana transformations of the Dirac Hemiltonian are discussed in a parallel way as special cases of two general unitary transformations for spin ½, which generalize to include all integer and half-integer spins for the Weaver-Hammer-Good class of massive-particle wave equations. It is further shown how to construct a matrix tilde $alpha_3^*$ for all spins, the generalization of $alpha_3$ for spin ½; and a discussion of "good" and "bad" components of operators and wave functions is given. (auth)

27431 REGGEON DIAGRAM TECHNIQUE FOR INCLUSIVE PROCESSES IN THE TRIPLE-REGGE LIMIT. Abarbanel, H. D. I. (Fermi National Accelerator Lab., Batavia, IL); Bartels, J.-Bronzan, J. B.; Sidhu, D. Phys. Rev., D; 12: No. 8, 2459-2481 (15 Oct 1975).

Rules are derived for evaluating Regge branch-cut corrections to the triple-Regge regime of inclusive reactions. The approach is to study classes of hybrid field-theory graphs for the six-point function and set up a constructive procedure for evaluating the contributions with discontinuities in the missing mass. It was found that all contributions, cut and pole, can be given in terms of a single partial-wave amplitude and the rules are for constructing that. The rules are then cast into a form appropriate for a Reggeon field-theory evaluation of this partial-wave amplitude, and a renormalization-group attack on the problem is outlined. This latter work is especially relevant for the case when Pomeron ex-

change is permitted and a nonperturbative evaluation of the partial-wave amplitude near J/sub l/ approximately 1 and t/sub l/ approximately 0 is required. (auth)

27432 ELECTROPRODUCTION IN A STREAMER CHAMBER: MULTIPLICITIES, INCLUSIVE CROSS SECTIONS AND VECTOR MESON PRODUCTION. Nagel, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). pp v.2 p.247-266 of High Energy Leptonic Interactions. Proceedings of the 9th Rencontre de Moriond. Meribel-les-Allues (France), March 3-15, 1974. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11, Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Hadron production by ep scattering in the kinematical region $0.3 < Q^2 < 1.5$ GeV^2 and $1.3 < W < 2.8$ GeV^2 was studied in a streamer chamber at DESY. The average multiplicity of charged hadrons n is consistent with a logarithmic s dependence: $n \sim 0.8 + \ln s^2/m_p^2$. The multiplicity does not scale with respect to ω' and ω_W. The normalized invariant π^- cross section, F(x), for fixed W shows no Q^2 dependence if ρ^0 events are removed from the data. In the non diffractive region, $3.5 < \omega' < 10$, the slope of the p^2 distribution decreases with Q^2 for fixed ω'. In the beam fragmentation region a longitudinal/transverse interference term was observed. The Q^2 dependence of $\sigma(\gamma_v p \rightarrow \rho\text{-}0\ p)$ and $\sigma(\gamma_v p \rightarrow \omega p)$ is essentially determined by the ρ/ω propagator as suggested by VDM. For $W > 2.2$ GeV the decay angular distributions in the helicity system show that ρ zero mesons are produced predominantly by transverse photons but a nonzero contribution is also seen. (FR)

27433 ON RELATIVISTIC MULTIPARTICLE KINEMATICS IN INVARIANT VARIABLES. Gheorghe, A.; Ion, D. B.; Mihul, E. (Joint Inst. for Nuclear Research, Dubna (USSR)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 2, 131-142(1975).

A complete system of algebraic constraints on the Gram matrices of four-momenta and an analytic reconstruction of any finite set of four-momenta from their Gram matrix are established. The physical regions and phase-space volume elements in general invariant variables of both exclusive and inclusive multiparticle processes are also given. (FR)

27434 HAMILTON FORM AND CONSERVATIVE SYSTEMS. Bel, L. (Paris-6 Univ., 75 (France)); Martin, J. Ann. Inst. Henri Poincare, Sect. A; 22: No. 3, 173-199(1975). (In French)

The Hamilton Form (H.F.) in the past (resp. future) of a predictive Poincare invariant system (P.I.S.) is defined. Under rather general assumptions it is proved that the H.F.(s) in the past (resp. future), when they exist, are unique. A conservative system is defined as a P.I.S. for which the H.F.'s in the past and in the future exist and coincide. Conservative systems are the closest generalization of Hamiltonian non-relativistic systems. Using perturbation theory the authors prove, at the first order, the existence of H.F.'s in the past and in the future for short range P.I.S. and, with a slight change in the definition, the existence of not unique, H.F.'s for long range P.I.S. The paper ends with some applications of the general theory of H.F.'s and Conservative Systems including the calculation of the energy-momentum and the intrinsic angular momentum for scalar and vector interactions. (FR)

27435 DESCRIPTION OF THE REACTION $pp \rightarrow pp\pi^+\pi^-$ IN THE REGGEIZED OPE MODEL. Ponomarev, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 4, 807-821(Oct 1975). (In Russian)

The OPER is formulated analyzing the reaction $pp \rightarrow pp\pi^+\pi^-$. The model depends upon three parameters. The energy behavior of the reaction under consideration is quantitatively described from 2 to 205 GeV/c as well as the transfer momentum distributions and the distributions of masses of pairs of particles and of the $p\pi^+\pi^-$ system mass. Analysis of the studied characteristics of the reaction $pp \rightarrow pp\pi^+\pi^-$ shows a satisfactory quantitative agreement between the theory and the data. 11 figures, 1 table. (auth)

27436 NEW DUAL MODEL WITH DYNAMICAL COLOR. Manida, S. N. (Leningrad State Univ.). Yad. Fiz.; 22: No. 4, 833-836(Oct 1975). (In Russian)

A modification of the dual quark-gluon theory with dynamical color is presented. The quark-gluon scattering amplitude in this model has the poles in quark-antiquark channel in contrast to the branch points in previous model. (auth)

27437 MULTIPLICITY DISTRIBUTION OF PIONS IN THE STATISTICAL BOOTSTRAP MODEL WITH NO ACCOUNT FOR EXOTIC STATES. Kripfganz, J. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 4, 801-806(Oct 1975). (In Russian)

Multiplicity distribution in the fireball decay beam is investigated in the statistical bootstrap model with no account for exotic states. The asymptotics is found for this case. It is shown that the decay chain modifies the relative probabilities inessentially. The results of this model are compared with the results of the statistical bootstrap model with the exotic states taken into account. 1 table. (auth)

27438 ANALYTICAL PROPERTIES AND UNITARITY RELATION FOR RESONANCE-PARTICLE INTERACTION AMPLITUDE. Simonov, Yu. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 4, 845-859(Oct 1975). (In Russian)

The resonance-particle interaction amplitude is determined by means of the $3 \rightarrow 3$ transition amplitude. It is shown that different analytical continuations determine four different resonance-particle amplitudes. For all amplitudes the unitarity relations are written and it is found which amplitude is involved in the physical amplitudes directly measured. Analytical properties of the total resonance-particle interaction amplitudes and of their partial waves are studied on examples of simplest diagrams: pole, triangle and box graphs. It is shown that the obtained singularities do not prevent from using dispersion relations for the physical resonance-particle interaction amplitude. 19 figures. (auth)

27439 CONNECTION BETWEEN ELASTIC AND INELASTIC PROCESSES AT HIGH ENERGIES. Semenov, S. V.; Troshin, S. M.; Tyurin, N. E.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yad. Fiz.; 22: No. 4, 792-800(Oct 1975). (In Russian)

The connection between elastic and inelastic processes at high energies is studied. It is shown that the spectral density of the contribution from inelastic channels is related to the multiplicity distribution function of secondary particles by means of the Laplace transformation. The known value of the contribution from inelastic channels is used to obtain the multiplicity distribution which is in a good agreement with data and gives correct values of the first 10 momenta of the distribution. 5 figures, 6 tables. (auth)

27440 NEW CONSTRAINTS FOR PARTICLE DECAYS AND Ω^- REVISITED. Makhopadhyay, P. (Jadavpur Univ., Calcutta). Indian J. Phys.; 49: No. 9, 668-690(Sep 1975).

Some new constraints are introduced for studies on particle decays. These new constraints are in the nature of certain dimensional constraints. It was shown that all the decay modes (not occurring through subreactions) which may occur in nature for an unstable particle can satisfy one and only one of the two constraints $d \geq D$ and $d \leq D$ where d is the magnitude of a kind of dimension of the field of the decaying particle and D is the sum of the d values for the fields associated with particles constituting a decay mode. For a particular unstable particle d is fixed whereas D can take, in principle at least, a spectrum of discrete values. The new constraints were derived by assuming the fields associated with the particles involved in decay processes as free fields. The constraints concerned can account for the nonoccurrence in nature of most of the theoretically allowed but not experimentally observed decay modes of unstable particles. The constraint appropriate for the decay of $\rho'(1600)$ successfully explains why the 2π mode has not been experimentally detected and at the same time strongly supports the resonance interpretation for $\rho'(1600)$. Also the new constraints can accurately predict the spins of unstable particles provided sufficient experimental information are available on particle decay modes. The spins of the unstable particles predicted by the new constraints are in excellent agreement with the same obtained by the conventional methods for spin assignments. The constraint appropriate for the decay of Ω^- predicts the value $\frac{3}{2}$ for its spin which is its SU_3 predicted value. (auth)

27441 MULTIPLE GENERATION OF HADRONS IN VAN DER WAALS APPROXIMATION FOR THE FEYNMAN GAS. Mal'tsev, V. M.; Dushhutin, N. K.; Sinegovskii, S. I. (Joint Inst. of Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 5, 1051-1056(Nov 1975). (In Russian)

Multiplicity distributions and correlation parameters of multiple generation of hadrons are considered. It is shown that in a Feynman gas analogy Van der Waals equation corresponds to a model with a combined mechanism of secondary particle production in the random process approximation. The values of the own volume of the Feynman gas particles, obtained by comparing with data, differ from the theoretical values calculated by postulating a phase transition. (auth)

27442 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 13, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 84p.

27443 COMPOSITE PARTICLE REACTION THEORY. Wilson, J. W. Williamsburg, VA; Coll. of William and Mary (1975). 86p. University Microfilms Order No. 76-719.

Thesis (Ph. D.).

An effective potential operator is derived from the multiple-scattering series expansion of the exact transition amplitude for scattering two composite particles. This effective potential operator is used in a high energy context to derive an approximate one-body Schroedinger equation by use of the closure approximation. The equivalent one-body equation is reduced to a set of coupled channel equations which relates the entrance channel to the final excited states of the projectile and target. A Schroedinger equation for the coherent elastic amplitude is extracted from the coupled equation. Total and absorption cross sections are derived on the basis of the eikonal approximation and the assumption that the coherent scattering dominates the elastic scattered amplitude. The equations are applied to the nuclear scattering problem and dependence of the total and the absorption cross sections on the model used for single particle densities is examined. The Saxon–Woods form factors show excellent agreement with neutron-nucleus cross sections. Absorption cross sections for heavy ion absorption on various target nuclei are calculated with some comparisons with the limited available experimental data. The use of geometric cross sections are found to be valid only when both target and projectile are heavier than argon at intermediate energies since nuclei show a rather high degree of transparency. Factorization of the total cross sections is found to be only in the limited geometric sense. (Diss. Abstr. Int., B)

27444 CARDINAL FUNCTION METHOD OF SOLUTION OF THE KLEIN–GORDON EQUATION. Lundin, L. R. Salt Lake City; Univ. of Utah (1975). 89p. University Microfilms Order No. 75-19,892.

Thesis (Ph. D.).

The steady-state form of the Klein-Gordon equation is given by (*) DELTA u equals u - u^3, u equals u(X), for solutions which are spherically symmetric, (*) takes the form u'' + 2u'/r equals u - u^3, u equals u(r), where r is the distance from the origin in R^3. The function y equals ru satisfies (**) y'' equals y - y^3/r^2. It is known that (**) has solutions (y/sub n/) /sub n equals 1//sup infinity/, where y/sub n/ has exactly n zeros in (0, infinity), and where y(0) equals y(infinity) equals 0. Approximations are obtained for the solutions y_0 and y_1. (Diss. Abstr. Int., B)

Electromagnetic

Refer also to abstract 27940.

27445 (CNRS-CPT-74-P-639, pp 44-55) ASYMPTOTIC NEAR FREEDOM. Bailin, D. (Univ. of Sussex, Brighton, Eng.). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

The anomalous dimensions of the tensor operators which occur in the light cone expansion for e^- or ν production are calculated. Restriction is made to the scalar gluon theories. (JFP)

27446 (COO-3533-64(Vol.2), pp V.22-V.41) ANNIHILATION OF e^+e^- AND ANTI pp STATISTICAL MODEL CONSIDERATIONS. Margolis, B. (McGill Univ., Quebec). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5–8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

A comparison was previously made of the e^+e^- annihilation data for multiplicities and $pi^+ pi^- pi^+ pi^-$ final states with data for the corresponding quantities in anti pp annihilation as a function of energy. These data show considerable similarity. This similarity leads one to consider a statistical picture for the two reactions based on an incoherent superposition of resonances in the s-channel. Due to the high density of states in the picture developed, the final results are smooth functions of energy in which the phase space for any channel plays the dominant role. Specifically the statistical bootstrap model in which the s-channel resonances decay, sequentially emitting pions one at a time. (JFP)

27447 (CRN-HE-75-13) NEUTRAL CURRENTS AND HIGH-ENERGY LEPTON-NUCLEON ELASTIC SCATTERING. Fleury, N.; Leite Lopes, J. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Center de Recherches Nucleaires). 1975. 7p. INIS.

The Salam-Weinberg model of unified weak and electromagnetic interactions predicts the existence of heavy neutral vector mesons Z^0 responsible for neutral current couplings. Due to its large mass, it is expected that the contribution of the interaction which results from the exchange of this heavy meson is very small as compared to that of the electromagnetic interaction. The calculus of the differential cross section for lepton-nucleon elastic scattering shows that this contribution is negligible. (FR)

27448 (DESY-F-1-72/7) PHOTOPRODUCTION OF Δ(1,236) ON THE REACTION $\gamma p \rightarrow \pi^+\pi^- p$ WITH A PHOTO BEAM OF 5.8 GeV MAXIMUM ENERGY. Lueke, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nov 1972. 95p. (In German). INIS.

From an experiment on the reaction $\gamma p \rightarrow \pi^+\pi^- p$ with a bremsstrahlung photon beam of 5.8 GeV maximum energy total and differential cross sections and decay matrix elements of $\Delta^{++}(1,236)$ and $\Delta^0(1,236)$ production are presented. The data can be qualitatively understood using a Bornterm model (with absorptive corrections) interfering with some contributions from resonance formation in the s-channel. At threshold a non-resonant S-wave with spin and parity $J^P = 3^-/2$ is dominant, which is due to the contact term. (DE)

27449 ELECTROMAGNETIC MASS-CORRECTIONS IN ASYMPTOTICALLY FREE THEORIES OF HADRONS. Kummer, W. (Technische Hochschule, Vienna). Acta Phys. Austriaca; 41: No. 1, 83-88(1975).

A calculation of the anomalous dimensions relevant for the electromagnetic selfmass of hadrons is reported. It has been done for the case of nonabelian gauge theories. (auth)

27450 ELECTROMAGNETIC MESON DECAYS AND MIXING ANGLES IN THE RELATIVISTIC QUARK MODEL. Flamm, D. (Univ., Vienna); Kielanowski, P.; Sanchez-Guillen, J. Acta Phys. Austriaca; 41: No. 1, 33-39(1975).

The radiative decays of pseudoscalar and vector mesons are calculated in a relativistic quark model based on the Bethe-Salpeter equation. The effective electromagnetic current of the quarks includes an anomalous magnetic moment term. The theoretical decay rates obtained from this model agree within ten percent with the experimental ones. (auth)

27451 RADIATIVE DECAYS OF VECTOR MESONS IN BROKEN SU(3) MODELS. Edwards, B.J.; Kamal, A.N. (Department of Physics and Theoretical Physics Institute, University of Alberta, Edmonton, Canada T6G 2E1). Phys. Rev. Lett. 36: No. 5, 241-244 (2 Feb 1976).

We have studied the radiative decays of the vector mesons in two SU(3) -breaking schemes. In our models we find it hard to reconcile the newly measured radiative widths of $\rho \rightarrow \pi\gamma$, $K^{0*} \rightarrow K^0\gamma$, $\varphi \rightarrow \pi\gamma$, and $\varphi \rightarrow \eta\gamma$ with the older measurements and upper bounds on other radiative rates. In particular we have difficulty in understanding the narrow radiative width of ρ and the upper bound on $K^{+*} \rightarrow K^+\gamma$. (auth)

27452 ALTERNATE FORMULATION OF ELECTRON-PHOTON INTERACTIONS IN RELATIVISTIC QUANTUM MECHANICS. Ruei, K.H. (Graduate Institute of Physics, Tamkang College of Arts and Sciences, Tamsui, Taiwan 251, Republic of China). Am. J. Phys. 44: No. 2, 153-157 (Feb 1976).

In this paper, we develop an alternate formulation of the electron–photon interaction in the framework of ordinary relativistic quantum mechanics (without second quantization). We use the Dirac equation of motion to recast the current density in a form linear in the photon wave function. This enables us to take the photon as the system and, regarding the electron as an "external field," to iterate the photon wave equation by the standard method. In particular, we deduce the second-order matrix elements of Compton scattering, pair annihilation, and pair creation. The results so obtained are, of course, identical with those of the usual formulation, where the electron is taken as the system and the radiation is treated as the external field. The present approach complements the usual one; together, the two approaches reveal the symmetry of quantum electrodynamics under interchange of source and field. (auth)

27453 COLOR GLUON EXCITATION AT FERMILAB. Rajasekaran, G.; Roy, P. (Tata Institute of Fundamental Research, Bombay 400005, India). Phys. Rev. Lett. 36: No. 7, 355-358 (16 Feb 1976).

In unified gauge theories with color (excitable by lepton probes), color effects become manifest in the asymptotic region through gluon terms. Several new results pertaining to these are derived and quantitatively discussed. These may be testable at energies higher than 50 GeV now available. (auth)

27454 ELASTIC ELECTRON-DEUTERON SCATTERING AT HIGH MOMENTUM TRANSFER. Gari, M. (Institut für Theoretische Physik, Ruhr-Universität Bochum, Bochum, Germany); Hyuga, H. Phys. Rev. Lett. 36: No. 7, 345-348 (16 Feb 1976).

We show that a careful conventional treatment of exchange currents in the calculation of the deuteron form factor [$0 \leq q^2 \leq 8$ (GeV/c)^2] is not in contradiction with experiment. It rather shows an over-all good agreement. We propose measurements of the deuteron form factor at momentum transfer much higher than $q^2 \simeq 100$ fm^{-3} in order to obtain valuable information on the neutron form factor. (auth)

27455 MOVEMENT OF A NONRELATIVISTIC ELECTRON IN A FIELD OF PLANE ELECTROMAGNETIC WAVES. Arinshtein, A. E.; Flesher, G. I. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 129-130(1975). (In Russian).

Equations were derived which describe the behavior of a nonrelativistic electron in a field of plane electromagnetic waves. (JSR)

27456 RADIATION FROM A RELATIVISTIC ROTATOR. Borisov, A. V.; Matyukhin, A. A. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 118-122(1975). (In Russian).

The spectrum and total intensity of the radiation from relativistic cylindrical rotators were obtained with a consideration of the polarization and spin characteristics. Cases of small and large values of the parameter $\xi = (3/2)\ (\hbar/mcR)\ (E/mc^2)^2$, where E is energy and R is the radius of the electron orbit, were examined. (tr-auth)

27457 NEW PRECISE SOLUTION OF THE DIRAC EQUATION. V. Bagrov, V. G.; Byzov, N. N.; Gitman, D. M.; Klimenko, Yu. I.; Meshkov, A. G.; Shapovalov, V. N.; Shakhmatov, V. M. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 106-112(1975). (In Russian).

Four types of external electromagnetic fields were examined, assuming a precise solution of the Dirac and Klein–Gordon equations. The character of the electron motion in such fields was specified, however in the mathematical plan part of the problem was reduced to cases examined previously. (tr-auth)

27458 MONOPOLE–ANTIMONOPOLE BOUND STATE. Kyriakopoulos, E.; Ramachandran, R. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 15: No. 5, 161-165(31 Jan 1976).

An attempt is made to estimate the mass and other properties of a bound state arising purely out of a magnetic interaction and relate it to the form factor of the monopole. (JFP)

27459 ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON IN A MAGNETIC FIELD. Baier, V. N.; Katkov, V. M.; Strakhovenko, V. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Lett. Nuovo Cim.; 15: No. 5, 149-152(31 Jan 1976).

The dependence of an anomalous magnetic moment of the electron moving in the magnetic field upon the field intensity is found. It is shown that at $H \gtrsim H_0$ the value of the anomalous magnetic moment is essentially different from the Schwinger value $\alpha/2\pi$. (JFP)

27460 RADIATIVE DECAYS, PHOTOPRODUCTION AND TOTAL CROSS SECTION OF THE PSI PARTICLES. Sarma, K. V. L.; Rajasekaran, G.; Pasupathy, J. (Tata Inst. of Fundamental Research, Bombay). Pramana; 6: No. 1, 29-33(Jan 1976).

It is pointed out that the coupling characterizing the $\psi-\gamma$ vertex must change substantially between the limits, ψ on mass-shell which occurs in $\psi \to e^+e^-$ and photon on mass-shell which is relevant in radiative decays like $\psi \to \pi\pi\gamma$, $\psi \to \gamma\gamma$ and photoproduction of ψ. This has the consequence that the value of ψN total cross section must be larger than what is inferred from the use of naive vector dominance in photoproduction. (auth)

27461 RECONSTRUCTION OF PROTON ELECTROMAGNETIC FORM FACTOR IN THE TIME-LIKE REGION BY ITS VALUES IN THE SPACE-LIKE REGION. Geshkenbein, B. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 3, 601-608(Sep 1975). (In Russian).

Known analytical properties of the proton electromagnetic form factor are used to determine it in the time-like region by its values in the space-like region. It is impossible at any real experimental accuracy. An experimentally testable inequality (see eq. (22)) involving the integral of the form factor modulus squared is obtained. (auth)

27462 NOTE ON THE PROCESS $e^+e^- \to$ HADRONS. Novozhilov, V. Yu.; Prokhorov, L. V. (Leningrad State Univ.). Yad. Fiz.; 22: No. 3, 545-548(Sep 1975). (In Russian).

It is shown that at present time there are no serious reasons to conclude that there is contradiction between the data on the processes $e + p \to e + X$ (scaling) and $e^+e^- \to$ hadrons (no scaling). The arguments are presented for the fact that the ratio of the cross sections $R = \sigma_h/\sigma_\mu$ in the annihilation channel must slowly go to its limit. The examples considered are used to propose a formula for the function $R(Q^2)$ which agrees with the data at $Q^2 \gtrsim 5$ GeV^2, the function $R(Q^2)$ must show a considerable deviation from a linear growth at $Q^2 = 50$ to 100 GeV^2 already. (auth)

27463 FRAGMENTATION OF PHOTON INTO NEUTRAL VECTOR MESONS. Pirogov, Yu. F.; Ter-Isaakyan, N. L. (Erevan Physical Inst.). Yad. Fiz.; 22: No. 3, 539-544(Sep 1975). (In Russian).

The processes $\gamma p \to V^0X$; $ep \to eV^0X$ of inclusive photo- and electroproduction of neutral vector mesons $V^0 = \rho^0, \omega, \varphi$ are considered in the triple-Regge region. On the basis of available experimental data on elastic photo- and electroproduction $\gamma p \to V^0p$; $ep \to eV^0p$ and inclusive production $pp \to pX$ the fragmentation of $\gamma \to V^0$ is estimated at high energies. The possibility of the utilization of inclusive V^0 photo- and electroproduction processes to study the triple-Pomeron coupling is noted. (auth)

27464 ELECTRODISINTEGRATION OF DEUTERON INDUCED BY ELECTRON BACKWARD SCATTERING. Smirnov, S. A.; Trubnikov, S. V. (Mathematics Inst., Moscow). Yad. Fiz.; 22: No. 3, 503-511(Sep 1975). (In Russian).

A new relativistic integral representation, introduced by Yu. M. Shirokov, is used for the matrix element of deuteron electrodisintegration. This representation enables one to express the matrix elements of fields and currents in terms of the scattering matrix on mass shell only. The elastic neutron–proton interaction in the deuteron and in the final state is taken into account exactly. The effects of the meson exchange currents and inelastic np-channels are neglected. The calculated cross section of the threshold electrodisintegration of the S-wave deuteron induced by the electron backward scattering coincides with the experimental one in the interval $0.16 \leq q^2 \leq 5$ f^{-2}. The contributions from the relativistic effects and from the final-state interaction are also calculated. Dependence of the cross section on the choice of the scattering phase-shift parametrization is investigated. (auth)

27465 GAUGE THEORY WITH CALCULABLE NEUTRON–PROTON MASS DIFFERENCE. Wilkinson, D. J. Philadelphia; Univ. of Pennsylvania (1975). 92p. University Microfilms Order No. 76-3230.

Thesis (Ph. D.).

A spontaneously broken gauge theory of weak and electromagnetic interactions is constructed, in which the neutron-proton mass difference is finite and calculable. The model is one of a class in which the equality of the zero order neutron and proton masses is a natural relation (that is, it occurs for every choice of parameters of the theory); together with renormalizability, this implies that the mass difference must be finite in higher orders, since there are no counter-terms present which could absorb any divergence. The model is an extension to include strange particles of an SU2/sub L/ x SU2/sub R/ x U1 model suggested by Weinberg; neutral strangeness changing processes are suppressed using the Glashow, Iliopoulos, Maiani mechanism, which introduces a fourth "charmed" quark (or hadron) p', in addition to the usual p, n, lambda. Weak universality can easily, though not naturally, be achieved, and the model has the interesting prediction that in the effective hadron-neutrino four-point interaction, the hadron current is purely vector. The major disadvantage of the model is that, in addition to m(p) equals m(n), the model also predicts m(p') equals m(lambda) in zero order, and that the higher order corrections m(n) - m(p) and m(lambda) - m(p') should be comparable, which does not seem to be the case in nature. A calculation of the dominant neutral vector boson contribution shows both these mass shifts to be negative, and of the order of a few MeV. This problem is alleviated somewhat by imposing an additional discrete symmetry; this symmetry causes weak universality to be natural in the model, and also makes the neutron and proton massless in zero order (chiral SU2 symmetry). Thus a natural distinction arises between the doublets (p,n) and (p', lambda); in particular the dominant vector boson contribution to m(n) - m(p) is removed. (Diss. Abstr. Int., B)

27466 BREMSSTRAHLUNG AND PAIR PRODUCTION IN THE FIELD OF FREE ELECTRONS. Haug, E. (Tuebingen Univ. (F. R. Germany). Lehrstuhl fuer Theoretische Astrophysik). Z. Naturforsch., A; 30: No. 9, 1099-1113(Sep 1975).

14 figs.; 1 tab.; 31 refs.

A formula is given for the doubly differential cross section of electron-electron bremsstrahlung which is exact in lowest-order perturbation theory. Angular distributions and energy spectra of the emitted photon are calculated in the center-of-mass system and the laboratory system. The cross section for pair production in the field of an electron (triplet production) can be derived from the analogous bremsstrahlung formula using the substitution rule. Angular distributions and energy spectra of the produced positron as well as the total cross section for triplet production are computed in the laboratory system. The results for bremsstrahlung and pair production are compared with previous theoretical calculations. (DE)

27467 THEORY OF ULTRARELATIVISTIC ELECTRON RADIATION IN CLASSICAL ELECTRODYNAMICS. Boldyshev, V. F.; Shul'ga, N. F. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 21: No. 1, 10-17(Jan 1976). (In Russian)

A solution of the classical relativistic motion equation is obtained by means of the method of successive approximations by the inverse degrees of the incident particle energy. The obtained decomposition is used to calculate the elastic scattering cross section and radiation intensity. The obtained results are compared with formulas of quantum electrodynamics. (auth)

27468 PARTICLE CREATION AND SCATTERING BY THE NONSTATIONARY ELECTROMAGNETIC FIELD IN CANONICAL FORMALISM. Grib, A. A.; Mostepanenko, V. M.; Frolov, V. M. (Leningrad State Univ.). Teor. Mat. Fiz.; 26: No. 2, 221-233 (Feb 1976). (In Russian)

Particle creation and scattering by the nonstationary electromagnetic field of general form is considered. With the aid of the N. N. Bogoliubov method of canonical transformations the exact formulas for the density of boson and fermion pairs created by external field and amplitudes of transitions of the arbitrary initial state into the arbitrary final state are obtained. The direct connection is found between the "in" and "out" vacuum states. In the framework of the formalism suggested in general case the statement by R. P. Feynman is proved, which asserts that if one takes into account the particle creation by the field and the connection between spin and statistics the total probability of scattering is equal to unity. (auth)

27469 KINETIC EQUATION FOR ELECTRONS IN SYSTEMS OF CHARGED PARTICLES WITH STRONG INTER-ION INTERACTION. Klyuchnikov, N. I.; Trigger, S. A. (Inst. of High Temperatures, Moscow). Teor. Mat. Fiz.; 26: No. 2, 256-268(Feb 1976). (In Russian)

A simple derivation of the kinetic equation for electrons in systems of charged particles with the strong inter-ion interaction is given. The effect of shielding for the electron and ion Coulomb field is taken explicitly into account. (auth)

27470 ELECTROMAGNETIC CHARGE ASYMMETRY OF KAON ANGULAR DISTRIBUTIONS IN $e^+e^- \to K^+K^-$ PROCESSES NEAR THE ϕ RESONANCE. Sushkov, O. P. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yad. Fiz.; 22: No. 4, 868-870 (Oct 1975). (In Russian)

27471 SCATTERING OF PARTICLES IN THE PRESENCE OF ELECTROMAGNETIC WAVE. Berson, I. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 9-17(1975). (In Russian)

The problem of particles scattering by the central potential in the presence of a monochromatic electromagnetic wave is reduced to the solution of coupled differential equations. The boundary conditions for these equations are formulated, and expressions for the cross sections of the scattering with n-photon adsorption are obtained. The problem of multiphoton ionization is also considered. (auth)

27472 VECTOR-GLUON DOMINANCE AND PARTIAL SCREENING OF QUARK CHARGE. Krolikowski, W. Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 5, 617-622(1975).

The recently proposed explanation of the rising Drell ratio for e^-e^+ annihilation, provided by the vector-gluon dominance over the colored part of the photon, is discussed. This dominance leads to a new phenomenon of partial screening of quark charge, which is responsible for noninteger values of quark charges as "observed" in deep inelastic electron scattering. (auth)

27473 FIELD-THEORETIC FORMULATION OF PHOTON-HADRON INTERACTION. Lukierski, J.; Turko, L. (Univ., Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 5, 623-627(1975).

The choice of vector fields describing the Lagrangian dynamics of the γ-ρ system is discussed. The linear soluble model describing the hadronic structure of the photon is proposed. (auth)

27474 INTENSITY EFFECTS IN SCATTERING OF ELECTROMAGNETIC WAVES BY ELECTRONS MOVING IN EXTERNAL MAGNETIC FIELD. Ternov, I. M.; Bagrov, V. G.; Khalilov, V. R.; Rodionov, V. N. (Moscow State Univ.). Yad. Fiz.; 22: No. 5, 1040-1046(Nov 1975). (In Russian)

Radiation of an electron moving in the field of a plane electromagnetic wave and in a magnetic field is considered. The most important features of the radiation relativistic electrons are treated for the case of an arbitrary intensity of the magnetic field including the case of a field comparable with the Schwinger's field. (auth)

27475 KINETIC EQUATIONS OF A SYSTEM OF COULOMBIC PARTICLES IN A QUASI-RELATIVISTIC APPROXIMATION. Milant'ev, V. P.; Pasechnik, L. P. Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 7-12(1975). (In Russian)

From a set of equations by Bogolyubov by a general method given in the literature a kinetic equation is obtained for a system of particles with coulombic interaction with second-order corrections for relativistic effects, which in the classical limit (as c approaches infinity) coincides with an equation given by Landau. An equation is also derived with first-order corrections (quasi-relativistic analog of a kinetic equation by Vlasov). The quasi-relativistic approximation for a set of particles with coulombic interaction is constructed by means of Lagrangian formalism. (SJR)

27476 EFFECTS OF RADIATION DISSIPATION ON THE MOTION OF A CHARGE IN THE FIELD OF A PLANE, MONOCHROMATIC WAVE. Voloshchenko, A. M.; Pavlenko, Yu. G. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 13-19(1975). (In Russian)

It is shown that on motion of a charge in a plane monochromatic wave, radiation dissipation leads to swinging of oscillations in a plane perpendicular to the direction of wave propagation. An expression is obtained for the characteristic time of change in motion as a result of the radiation losses. It is shown that if the invariant parameter of the wave intensity $\xi \gg 137$, then the radiation dissipation in the classical region may have a substantial effect on the motion at a change in phase of the wave $\Delta\phi < 2\pi$. (SJR)

27477 SYNCHROTRON RADIATION OF RELATIVISTIC ELECTRONS IN A VERY STRONG MAGNETIC FIELD. Sokolov, A. A.; Borisov, A. V.; Zhukovskii, V. Ch. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 51-57(1975). (In Russian)

The synchrotron radiation spectrum is calculated for relativistic electrons without limitation on the magnitude of the magnetic field strength. It is shown that transitions to the ground level and also to weakly excited levels in very strong fields $H > H_0 = m^2c^3/e_0\hbar = 4.41 \times 10^{13}$ gauss contribute substantially to the total radiation intensity. In particular the contribution of the transition to the ground level (final electron energy $E' = mc^2$) with respect to transitions to the highly excited levels ($E' \gg mc^2$) for electrons with an initial energy $E = 10$ MeV in a field $H = 2H_0$ is 14%. (SJR)

27478 BREMSSTRAHLUNG RADIATION OF A NEUTRAL FERMI-PARTICLE IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE. Klimenko, Yu. I.; Kulish, V. V.; Khudomyasov, A. I. (Moscow Nontechnical Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 63-68(1975). (In Russian)

This study considers the bremstrahlung radiation of a neutral fermi-particle possessing anomalous magnetic and electric moments, in the field of a screened coulombic center in the presence of a plane electromagnetic wave. A study was made of the effect of polarization of the plane wave on the scattering cross section and spin behavior of the particle during scattering. Scattering cross sections are presented for the particle on the Coulombic center in the presence of constant, equal-in-magnitude and orthogonal electric and magnetic fields, and for a free particle. It is shown that in a number of cases the effect of an anomalous electric moment of the particle is determining. (SJR)

27479 THEORY OF RADIATION BY A CHARGED, CURRENT-CARRYING WIRE IN A TRANSPARENT, SINGLE-AXIAL CRYSTAL. Kukanov, A. B. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 86-90(1975). (In Russian)

A look is taken at the problems of Cherenkov radiation and synchrotron radiation by a charged, current-carrying wire in a transparent, single-axial crystal. Formulas are obtained for the spectral, intensity distribution of the radiation. A look is taken at the limiting transition of the formulas for the spectral intensity distribution of the synchrotron radiation to the corresponding formulas of the Cherenkov radiation. (SJR)

27480 INDUCED RADIATION OF A SCALAR PARTICLE IN THE FIELD OF TWO TRAVELING ELECTROMAGNETIC WAVES COLLIDING WITH EACH OTHER. Klimenko, Yu. I.; Kulish, V. V. (Moscow Nontechnical Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 140-141(1975). (In Russian)

This study considers the induced radiation of a spin-free particle (boson) moving in the field of two linearly-polarized electromagnetic waves traveling towards each other along unit vector n. Induced transitions in the field of one of the waves are noted. This process has been described in detail in the literature. Induced transitions are also obtained in the field of two waves, where the boson absorbs one photon of frequency ω_1, a photon

of frequency ω_2, and emits a photon of a third wavelength. An expression is given for the probability of induced radiation per unit time for a single boson. (SJR)

27481 POLARIZATION OPERATOR OF A PHOTON IN A VERY STRONG MAGNETIC FIELD. Skobelev, V. V. (Moscow Nontechnical Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 142-143(1975). (In Russian)

Very high magnetic fields with an induction $B \sim B_0 = m^2/e = 4.41 \times 10^{13}$ gauss can be formed, for example, on compressing the initial magnetosphere of stars during gravitational collapse. Such fields to a significant degree can amplify nonlinear quanto-electrodynamic (photon-photon scattering, the Delbrook effect, etc.), which are not observable under ordinary conditions. By means of Feynman technique in two-dimensional space this study calculates the polarization operator of a photon P(q) in a very strong magnetic field $B \gg B_0$, where at sufficiently small momenta q the transverse energy levels of vacuum electrons are not excited. The Green's function of an electron in a constant uniform magnetic field of arbitrary magnitude was found in the literature. The correction to the potential of a point charge Q in a very strong magnetic field $B \gg B_0$ is found to be negative, and in sufficiently strong fields the "bare" charge Q will be screened to a significant extent. (SJR)

27482 ELECTROMAGNETIC PROPERTIES OF THE DEUTERON. Hockert, J. W. Stony Brook, NY; State Univ. of New York (1975). 229p. University Microfilms Order No. 76-797. Thesis (Ph. D.).

Two problems in electron deuteron scattering are discussed. First, a completely covariant formalism for deuteron electrodisintegration is developed to lowest order in the fine structure constant. In the second calculation pseudodata from the Reid potential is used to consider the extent to which a single measurement of the tensor polarization of recoil deuterons in ed yields ed scattering can facilitate the separation of the deuteron charge and quadrupole form factors in the range o less than q^2 less than 35 fm^{-2}. (Diss. Abstr. Int., B)

27483 SOLUTIONS FOR THE MOTION OF AN ELECTRON IN ELECTROMAGNETIC FIELDS. Bagrov, V. G.; Gitman, D. M.; Jushin, A. V. (Tomsk Univ., USSR). Phys. Rev., D; 12: No. 10, 3200-3202(15 Nov 1975).

New exact solutions of the Lorentz, Hamilton–Jacobi, Klein–Gordon, and Dirac equations for an electron moving in the field of a plane wave and in electric and magnetic fields were found. The electric and magnetic fields are parallel to the direction of propagation of the plane wave. The magnetic field is constant and the electric field is an arbitrary function of the combination ct-z. (auth)

27484 SPIN-DEPENDENT CORRECTIONS TO COMMUTATION RELATIONS. Barone, S. R. (Polytechnic Inst. of New York, Farmingdale). Phys. Rev., D; 12: No. 10, 3363-3364 (15 Nov 1975).

By considering the dynamics of a magnetic dipole in the vicinity of a point charge, it is inferred that the commutation rules for velocity components must be modified to include spin-dependent terms. (auth)

Weak

Refer also to abstract 25497, 27606, and 27915.

27485 MASSIVE-PARTICLE PRODUCTION IN NEUTRINO SCATTERING. LoSecco, J.M. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 36: No. 6, 336-338 (9 Feb 1976).

It is found that the transverse momentum spectrum of the nonleading muon in dimuon events is consistent with their originating in the decay of a massive particle. (auth)

27486 EVALUATION OF THE PROBABILITY OF $K_1 \to 2\pi$ AND $K \to \pi\nu\bar{\nu}$ IN THE FRAMEWORK OF THE WEINBERG MODEL. Flambaum, V. V. (Inst. of Nuclear Physics, Moscow). Yad. Fiz.; 22: No. 3, 661-664(Sep 1975). (In Russian).

Probabilities of the rare decays of K mesons, previously calculated in the renormalized theory of electromagnetic and weak interactions and in the framework of the Weinberg model do not agree. An independent calculation of this decay is made. The formulas obtained agree with the expressions obtained in the calculations by the renormalized theory. The probabilities of the decays $K \to \pi\nu\bar{\nu}$ and $K \to \pi e\bar{e}$ were also recalculated and disagree with the results obtained in the use of the Weinberg model. (JSR)

27487 ISOTOPIC SYMMETRY: WEAK INTERACTIONS IN THE NONLINEAR REALIZATION SCHEME. Paziashvili, I. V.; Chkareuli, J. L. (Inst. of Physics, Tbilisi, USSR). Yad. Fiz.; 22: No. 3, 594-600(Sep 1975). (In Russian).

Weak interaction models are considered in the framework of gauge invariant nonlinear isotopic symmetry. Including of gauge fields into nonlinear theory results in two facts: scalar mesons totally disappear from the Lagrangian and vector mesons become massive. Higg's scalar do not appear. As a contrast to the linear spontaneous scheme, vector mesons may have different and arbitrary masses. This is due to the fact that the nonlinear scheme has fewer algebraic consequences than the linear one. But the condition unitarily correct behavior of "tree" amplitudes of fermion–antifermion pair annihilation into pairs of longitudinally polarized vector mesons leads to the algebraic realization of symmetry–isomultiplet structure of fermions with definite helicity. (auth)

27488 WEAK P-ODD NUCLEON–NUCLEON INTERACTION AND THE PROBLEM OF EXISTENCE OF A HIGH CHARACTERISTIC MASS. Danilov, G. S. (Leningrad Inst. of Nuclear Physics). Yad. Fiz.; 22: No. 4, 776-786(Oct 1975). (In Russian)

The problem of the quadratic divergence of the weak P-odd $NN\rho$ vertex $\Gamma(m_\rho^2)$ is discussed. It is shown that such a divergence is present if the interaction of currents on the light cone is not described by the free-quark model. In this case $\Gamma(m_\rho^2) \sim \Lambda^2$, where Λ is the cut-off parameter. If the free-quark model is applicable on the light cone, the value of $\Gamma(m_\rho^2)$ is finite and proportional to a characteristic mass M, squared. The magnitude of M^2 determines the region $k^2 > M^2$ (k is the W-boson momentum) where the free-quark model is valid. Recent experiments investigating the process $e^+e^- \to$ hadrons show that M^2 may be about 25 GeV^2 or even more. If Λ^2 (or M^2) were ~50 GeV^2, then the known contradiction between the theoretical estimates and experiment on the magnitude of the γ-quanta circular polarization in the reaction $n + p \to d + \gamma$ would vanish. 3 figures. (auth)

27489 RADIATIVE DECAYS OF π AND K MESONS AND A HEAVY LEPTON. Rekalo, A. P.; Khomenko, G. A. (Physical-Technical Inst., Kharkov). Yad. Fiz.; 22: No. 5, 1047-1050 (Nov 1975). (In Russian)

Contribution from a heavy lepton L to photon and positron spectra is calculated for the radiative decays π, $K \to e\nu\gamma$. The photon and positron spectra for the $K \to e\nu\gamma$ decay are sensitive to the contribution from the heavy lepton at those values of its mass and of the $L \to e\gamma$ coupling constant that are not excluded by experiments on search of the heavy lepton. (3 figures) (auth)

27490 QUARK CHARGES AND NUCLEAR β-DECAY. Wilkinson, D. H. (Oxford Univ.). Nature (London); 257: No. 5523, 189-193(18 Sep 1975).

The rate of β-decay is influenced by the charges of the nucleon's constituent quarks, and individual quark charges are estimated as $Q_p = 0.69 \pm 0.07$ and $Q_n = -0.29 \pm 0.15$. The subject is discussed under the following headings: the quark-parton model, radiative corrections, pure vector nuclear β-decay, conserved vector current and the Cabibbo angle, muon decay, quark charges, experimental data, and ϵ values. (UK)

27491 CURRENT ALGEBRA CONSTRAINTS ON K_{l3} FORM FACTORS. Simmons, L. D. Lafayette, IN; Purdue Univ. (1975). 192p. University Microfilms Order No. 76-590. Thesis (Ph. D.).

New theoretical constraints on the divergence form factor in K_{l3} decays are derived. The assumptions underlying the derivation are presented. The constraints on the divergence form factor are derived and summarized in the form of a theorem. It is shown that the finiteness of the leakage charge is a natural consequence of the parallel DELTA I vector parallel equals ½ rule. The Lorentz invariance of current algebra sum rules is discussed. The theorem is rederived within the context of the conserved vector current hypothesis. Finally, the implications of the present work are noted with attention being paid to both the theoretical and experimental consequences. (Diss. Abstr. Int., B)

Strong (General)

Refer also to abstracts 27869 and 27919.

27492 SUPERSYMMETRY AND PARASTATISTICS. Vladimirskii, V. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 4, 870-871(Oct 1975). (In Russian)

27493 NEW MESONS AND A MODEL OF STRONG INTERACTIONS OF INTERMEDIATE BOSONS. Berkov, A. V.; Zhizhin, E. D.; Nikitin, Yu. P. (Moscow Engineering-Physics Inst.). Yad. Fiz.; 22: No. 4, 865-867(Oct 1975). (In Russian)

27494 SOME FEATURES OF HIGH ENERGY HADRON–HADRON COLLISIONS. Roy, S. R.; Bhattacharyya, D. P.; Roychoudhury, R. K.; Basu, D. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 49: No. 3, 249-252 (Mar 1975).

It is shown that if one plots the quantity $\langle n_c(n_c-1)\rangle/\langle n_c\rangle$ for the multiplicity of high energy hadron interactions against Q is equally a good tendency for the data to lie on a universal curve which is shown. (JFP)

Strong (Baryon No. = 0)

Refer also to abstracts 27365, 27902, and 27916.

27495 (COO-3533-64(Vol.2), pp V.6-V.21) STATISTICAL PROPERTIES OF NUCLEON–ANTINUCLEON ANNIHILATION. Vandermeulen, J. (Univ., Liege). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume 2. Chapters 5–8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

It is found that the statistical bootstrap approach provides a framework for a fruitful interpretation of the general properties of the final states from anti NN annihilation in the vicinity of the N anti N threshold; it implies a mechanism of formation and decay of a single fireball or cluster. It is found that an interpretation of the same type applies to annihilation at rest and to annihilation in flight at low momenta. The following constraint should be placed on any model for anti NN annihilation at intermediate energies below 2 GeV/c: at smooth transition from the scheme of single cluster, formation should be ensured. (JFP)

27496 (COO-3533-64(Vol.2), pp VIII.1-VIII.91) NARROW n ANTI n RESONANCES. Bogdanova, L. N.; Dalkarov, O. D.; Kerbikov, B. O.; Shapiro, I. S. (Inst. for Theoretical and Experimental Physics, Moscow). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA((2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume 2. Chapters 5–8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

The present status of the problem of quasinuclear states in systems of nucleons and antinucleons is reviewed. The theoretical predictions are compared with experimental data on narrow meson resonances near N anti N threshold which appeared in 1971-74. (auth)

27497 (COO-3533-64(Vol.2), pp VIII.92-VIII.123) POSSIBILITY OF NARROW RESONANCES OF THE OMEGA ANTI OMEGA-SYSTEM. Duerr, H. P. (Max-Planck-Institut fuer Physik and Astrophysik, Munich). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume 2. Chapters 5–8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

The possibility of resonances of the OMEGA anti OMEGA-system is discussed on the basis of the medium and long range meson exchange forces. The total and partial widths of these resonances are estimated by using well known formulas of nuclear physics. It is demonstrated that analogously the phi- and rho-mesons may be interpreted as p-states of the K anti K- and pi pi-system, respectively. There appears, however, only a slim chance to interpret the new narrow resonances psi (3100) and psi (3700) as $^7d_1$- and $^7g_1$-OMEGA anti OMEGA configurations. (auth)

27498 (COO-3533-64(Vol.2), pp VIII.136-VIII.143) alpha-PARTICLE-LIKE MODELS OF THE J AND psi MESONS. Robson, D. (Florida State Univ., Tallahassee). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume 2. Chapters 5–8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

A new quantum number called B-spin is introduced to describe nucleons and anti-nucleons as identical particles. Two, three, and four particle systems are considered and an identification of the J(3095) and psi (3685) narrow resonances recently observed is made with meson analogs of the conventional alpha-particle. The psi (3685) is described as an alpha-meson with one unit lower B-spin than the alpha-particle and has a similar mass to the alpha-meson which results from a simple rotation in B-spin space. The J(3095) is described as a quark-anti-quark hole in the alpha-meson which has the same B-spin as the conventional alpha-particle. (auth)

27499 (LPC-75-02) $\bar{p}$ p PARTIAL-WAVE ANALYSIS AT 400 AND 500 MeV/c. Laloum, M. (College de France, 75–Paris. Lab. de Physique Atomique et Moleculaire). 1975. 9p. INIS.

A partial-wave analysis of the $\bar{p}$ p elastic scattering, at fixed momenta 400 and 500 MeV/c (lab.) was performed. It is mainly assumed that most of the amplitude comes from orbital momenta $l \leq 2$. Although polarization values are lacking, adjustment to available experimental data leads to a restricted number of solutions, because of strong unitarity constraints. (FR)

27500 (LPNHEX-TS-75-01) ONE MESON π^0 FINAL STATE STUDY IN NEUTRAL CURRENT NEUTRINO AND ANTINEUTRINO INTERACTIONS. Comtet, A. (Ecole Polytechnique, 75–Paris (France). Lab. de Physique des Hautes Energies; Paris-6 Univ., 75 (France)). 1975. 103p. (In French). INIS.

Neutral pion production by weak neutral currents was observed in the CERN-GARGAMELLE neutrino experiment. The aim of the analysis was the measurement of the ratios $R(\nu)$ and $R(\bar{\nu})$ of neutral-current to charged-current cross sections. The background due to neutron interactions was computed. A lower and an upper limit of the background was obtained. Bounds on the ratios $R(\nu)$ and $R(\bar{\nu})$ are given using these limits: $0.11 < R(\nu) < 0.22$; $0.16 < R(\bar{\nu}) < 0.52$. Theoretical predictions for $R(\nu)$ were obtained in the framework of the Weinberg-Salam model. It is not possible to compare the experimental results with these theoretical evaluations because of nuclear corrections. (FR)

27501 LOW ENERGY PARAMETERS FOR SCATTERING OF PIONS AND KAONS. Palou, F. P.; Sanchez Gomez, J. L.; Yndurain, F. J. (Universidad Autonoma de Madrid (Spain). Departamento de Fisica Teorica). Z. Phys., A; 274: No. 2, 161-164(1975).

4 tabs.; 9 refs.

Scattering lengths and some effective range parameters for processes $\pi\pi \to \pi\pi$, $\pi\pi \to K\bar{K}$, $K\bar{K} \to K\bar{K}$ are calculated, the last at both 2 π and $K\bar{K}$ thresholds. The calculations are made (i) using experimental data (when possible), (ii) using the Veneziano model. (DE)

27502 COLOR SYMMETRY IN THE LARGE-n LIMIT. Canning, G. P. (Niels Bohr Inst., Copenhagen). Phys. Rev., D; 12: No. 8, 2505-2513(15 Oct 1975).

The selection of certain dominant topological classes of Feynman diagrams in the large-n limit in the context of a non-Abelian gauge field theory, where the nontrivial couplings of the regular representation of the group are involved is investigated. It is found that nonplanar diagrams are suppressed relative to locally planar diagrams by factors of $1/n^2$ in the case of SU(n) and by factors of $1/n$ in the case of SO(n) or Sp(n). The concrete example of the meson bound states in a theory of colored quarks bound by colored gauge vector gluons, where the topological selection corresponds to that required for hadrons in a dual theory, is considered. (auth)

27503 RENORMALIZATION OF FOUR-FERMION OPERATORS IN ASYMPTOTICALLY FREE THEORIES. Yen, H. C. (National Tsing Hua Univ., Hsinchu, Taiwan); Shih, I. F. Chin. J. Phys. (Taiwan); 13: No. 2, 205-223(Oct 1975).

Assuming that the strong interactions are described by SU(N) color-gauge theories, one can calculate the logarithmic "enhancement" factors of various operators which contribute to the lowest order weak and e.m. transitions between hadronic states. The enhancement factors of four-fermion operators are computed and it is shown that the usually assumed V–A type four-fermion operators do not have larger enhancement factors than some of the other types, such as the scalar, pseudoscalar, or tensor types. (auth)

Strong (Baryon No. = 1)

27504 (COO-3533-64(Vol.2), pp VI.24-VI.29) DEUTERON FUSION "CATALYSIS" BY ANTIPROTONS. Kalogeropoulos, T. E. (Syracuse Univ., NY). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon–antinucleon interactions. Volume 2. Chapters 5–8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

In the course of an event by event study of 3000 antiproton annihilations in a deuterium bubble chamber, seven events were found which are not interpretable in terms of pure anti pd annihilations on the basis of baryon number and charge conservation. The frequency of these zoo events after considering analogous events involving neutrons is close to approximately 10^{-2}. Two instrumental sources were each considered as possible interpretations, but the first is ruled out and the second considered unlikely. (JFP)

27505 (COO-3533-64(Vol.2), pp VIII.144-VIII.147) EXPERIMENTAL CONFIRMATION OF THE ANTI pp RELATIVE INTRINSIC PARITY. Kalogeropoulos, T. E. (Syracuse Univ., NY). 1975.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5-8. (Syracuse Univ., N.Y. (USA). Dept. of Physics).

It is concluded that the present and forthcoming experimental results show that the proton has opposite intrinsic parity to the antiproton. (JFP)

27506 (INR-1471/7/PH/A) EFFECTIVE POTENTIAL AND OFF-SHELL TWO-BODY SCATTERING AMPLITUDES IN THE EIKONAL APPROXIMATION. Bartnik, E. A.; Rek, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 25p. INIS.

An effective potential is computed for two-body elastic scattering with the experimental on-shell t-matrices as an input. Nonrelativistic eikonal approximation and locality together with spherical symmetry of potential are assumed. The explicit form of potential for pp, π^+p, and π^-p in the energy range from 5 to 20 GeV is investigated. The half off-shell scattering amplitude is calculated in the potential model. In the position representation this amplitude is found to be asymmetric along the eikonal direction, and an interesting absorption interpretation of this fact is given. (auth)

27507 (PUC-TN-10/74) K^+p SCATTERING WITH UNITARY PADE APPROXIMANT. Andrade, S. C. B.; Ferreira, E.; Chang, L. Y. (Pontificia Universidade Catolica do Rio de Janeiro (Brazil). Instituto de Fisica). Aug 1974. 46p. INIS.

The K^+p system is studied with the Pade approximants method. From a lagrangian written in terms of kaon, nucleon and hyperon fields the [1,1] Pade approximant is evaluated for the s, $p_{\frac{1}{2}}$ and $p_{\frac{3}{2}}$ waves. Our results for differential and total cross sections, polarization and phase shifts are compared with experimental data at low energies and with solutions of phase shifts analysis. It is found that the model describes very satisfactorily all the available data on the K^+p interaction at low energies. (auth)

27508 GEOMETRICAL DESCRIPTION OF MESON-BARYON INTERACTIONS. Alderman, J. L. (Virginia Commonwealth Univ., Richmond); Bergmann, O. Acta Phys. Austriaca; 41: No. 1, 65-73(1975).

Starting from a lagrangian for a quark field, a generalization of the Yang-Mills theory is considered in which the gauge potentials (affinities) are allowed to couple the space-time (spinor) and the intrinsic (SU(3)) indices. The specific form of the coupling is determined by invariance considerations and by the demand of current conservation. The affinities contain a pseudoscalar octet which is identified with the meson field. The application to the spin $\frac{1}{2}$ baryon octet gives the usual meson-baryon coupling with a D/F ratio of $\frac{9}{7}$, corresponding to $\alpha = \frac{9}{16}$. The free lagrangian for the meson field is formed from the intrinsic "curvature" tensor and contains besides the usual quadratic terms a self-interaction of the form Φ^4. An invariant mass term for the meson field can also be added. This formalism suggests a reformulation of gravitational theory, which is indicated. (auth)

27509 DESCRIPTION OF THE REACTION $\pi^-p \to \pi^+\pi^-n$ IN THE REGGEIZED OPE MODEL. Nilov, A. F.; Garanina, T. A.; Lomkatsi, G. S.; Pnonmarev, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 3, 583-593(Sep 1975). (In Russian).

The results of analyzing 4875 events of the reaction $\pi^-p \to \pi^+\pi^-n$ at 4.5 GeV/c momentum are presented. The parameter of the modified version of the OPER model is determined: $R_1^2 = 2.5$ $(GeV/c)^{-2}$. The experimental data at 4.5 and 17.2 GeV/c momenta are described in the framework of the model. The dependence of the reaction cross section upon the incident π^--meson momentum is presented. (auth)

27510 3π SYSTEM PRODUCTION IN THE REACTION $\pi^-p \to p\pi^+\pi^-\pi^-$ AT 4.5 GeV/c. Beketov, G. V.; Zombkovskii, S. M.; Kaidalov, A. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 3, 525-529(Sep 1975). (In Russian).

Characteristics of the 3π system production and decay in the reaction $\pi^-p \to p\pi^+\pi^-\pi^-$ at 4.5 GeV/c were studied in liquid hydrogen bubble chambers. Variation of the slope of the differential cross section $d\sigma/dt$ with 3π masses is presented. Helicity conservation in production of a peripheral 3π system is considered. Obtained results are well fitted by the Regge pole exchange model. (auth)

27511 ASYMPTOTICAL BEHAVIOR OF THE FORM-FACTORS AND INVARIANT DESCRIPTION OF SPATIAL STRUCTURE OF PARTICLES. Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 25: No. 3, 313-326 (Dec 1975). (In Russian)

Invariant description of the particle spatial distribution is introduced on the basis of relativistic configurational representation obtained with the aid of expansions over unitary representations of the Lorentz group. A formula which gives the correct "almost dipole" asymptotical behavior of the proton form factor $F_p(t) \to \ln|t|/M^2/t^2$ at large -t is obtained. (auth)

27512 UNIFORMIZATION OF THE FORWARD-SCATTERING AMPLITUDE AT HIGH ENERGY. Gerdt, V. P.; Inozemtsev, V. I.; Meshcheryakov, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Lett. Nuovo Cim.; 15: No. 9, 321-328(28 Feb 1976).

An analysis is given of attempts to simplify the dispersion relation technique via a change of dispersion integrals into differential operators is given. The π^+ + p forward elastic scattering is considered as an example. (JFP)

27513 STRIKING POLARIZATION EFFECTS IN $\pi^-p \to \pi^0n$ AS A TEST OF UNCONVENTIONAL ASYMPTOTIC BEHAVIOR. Joynson, D. (Institut de Physique Nucleaire, Paris); Leader, E.; Nicolescu, B.; Lopez, C. Lett. Nuovo Cim.; 15: No. 11, 397-401(13 Mar 1976).

It is pointed out that data at t = 0, if taken seriously, give rise to striking predictions for the $\pi^-p \to \pi^0n$ polarization in the energy range 5 to 240 GeV/c. This provides a very sensitive test of any unexpected behavior in the charge exchange amplitude and at the same time a consistency check on the measurements of $\Delta\sigma$ and $d\sigma/dt$ at t = 0. (JFP)

27514 BREAKING THE SYMMETRY OF THE DECOUPLET OF BARYON RESONANCES $3^+/_2$. Szymanowski, L. Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 9, 1019-1023(1975).

Assuming the spontaneous symmetry breaking the mass splitting within the decouplet of baryon resonance $3^+/_2$ was calculated. It turned out that one did not have relations obtained in the context of the tadpole model. (auth)

27515 RADIATIVE WIDTHS OF VECTOR MESONS IN HADRON REACTIONS. Azimov, Ya. I.; Levin, E. M.; Ryskin, M. G.; Khoze, V. A. (Leningrad Inst. of Nuclear Physics). Yad. Fiz.; 22: No. 4, 763-775(Oct 1975). (In Russian)

The $\pi^2(K^2) + p(^4He) \to \rho^2(K^{*2}) + p(^4He)$ reactions are studied at high energies s and small transverse momentum transfers q. The one-photon contribution region is estimated (for a proton $q^2 < 10^{-3}$ GeV^2 at $s = 100$ GeV^2 and $q^2 < 10^{-2}$ GeV^2 at $s = 800$ GeV^2) as well as the region where the interference of strong and electromagnetic interactions is essential. Measurements in those regions allow to find the radiative widths of vector mesons. It is shown that at not too high energies ($E_{lab} < 100$ GeV) the vector meson production on ^4He is the most profitable because in that case the π meson exchange is absent and the electromagnetic contribution becomes essential at higher q^2. 1 table, 7 figures. (auth)

27516 AZIMUTHAL CORRELATION IN THE INDEPENDENT CLUSTER MODEL. Ranft, G.; Ranft, J.; Sabau, M.; Solomin, A. N.; Fadeev, N. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 4, 822-832(Oct 1975). (In Russian)

Data on the azimuthal correlations and their rapidity dependence are presented in the $\pi^-p \to \pi^+\pi^-X$ and $\pi^-p \to \pi^+\pi^-X$ at 40 GeV/c. They show a long range as well as a short range effect. The short range effect leading to the different behavior of $dN/d\varphi$ near $\varphi \sim 0$ of the like and unlike pion pairs is explained by statistics. The predictions of the independent cluster model for the azimuthal asymmetry are in qualitative agreement with data of this experiment as well as those at 102 and 205 GeV/c. 3 tables, 5 figures. (auth)

27517 FIVE AND SIX CHARGED PARTICLE FINAL STATES IN pi^+D INTERACTIONS AT 13.1 GeV/c. Badewitz, R. C. Lafayette, IN; Purdue Univ. (1975). 168p. University Microfilms Order No. 76-493.

Thesis (Ph. D.).

The charge exchange reactions pi^+n yields $p2pi^+2pi^-$ and pi^+n yields $p2pi^+2pi^-pi^0$ along with the reaction pi^+n yields $n3pi^+2pi^-$ are analyzed within the context of their characteristic kinematic and dynamic properties. The various final states are considered as semi-inclusive reactions where the differences in multiplicity are contrasted. A test of factorization of phase space variables is found to be only partially satisfied. Dynamic features of the reactions are found to be clouded by the permutation ambiguity of identical particles in the final state. The binary LPS method of analysis is employed to qualitatively understand the reaction mechanisms, and the validity of this method is also tested. (Diss. Abstr. Int., B)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 27587, 27589, and 27787.

27518 (COO-3533-64(Vol. 2)) PROCEEDINGS OF THE IV INTERNATIONAL SYMPOSIUM ON NUCLEON-ANTINUCLEON INTERACTIONS, SYRACUSE, NEW YORK, 2–4 MAY 1975. Volume 2. Chapters 5–8. Kalogeropoulos, T. E.; Wali, K. C. (eds.). (Syracuse Univ., N. Y. (USA). Dept. of Physics). 1975. 325p. (SU-4206-64(Vol. 2); CONF-750547-P2). Dep. NTIS $9.75.

From 4th international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

The conference contained 20 papers. Separate abstracts were prepared for 15 papers. Five papers appeared previously in NSA; for abstracts of these papers see CONF-750547-P2. Four of these papers also appear in ERA. (JFP)

For abstracts of individual papers see: 27385–27388, 27406, 27407, 27446, 27495–27498, 27504, and 27505.

27519 (CERN-HE-75-7) STUDY OF CHARGED MULTIPLICITY DISTRIBUTIONS IN $\bar{p}$ n INTERACTIONS AT 5.55, 9.3, AND 14.6 GeV/c. Fridman, A.; Gerber, J. P.; Juillot, P.; Michalon, A.; Michalon-Mentzer, M. E.; Voltolini, C.; Plano, R. J.; Sheng, A. P.; Brucker, E. B.; Koller, E. L. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires). 1975. 42p. INIS.

From 1975 high energy particle physics conference; Palermo, Italy (23 Jun 1975).

Based on three bubble chamber experiments carried out at Argonne (5.55 GeV/c), CERN (9.3 GeV/c) and Brookhaven (14.6 GeV/c) a study of multiplicity distributions obtained from $\bar{p}$ n interactions is presented. Only events having a visible track stopping in the chamber were used for the present analysis thus allowing to extract easily the coherent reactions from the data. The topological cross sections as well as various statistical moments obtained from the charged multiplicities are studied as functions of the incident momentum. Some comparison between the results and $\bar{p}$ p and pp data is made. (FR)

27520 (IC-74-103) A COMMENT ON DOUBLE SCATTERING EFFECT IN DEUTERON BREAK-UP REACTIONS. Alberi, G.; Rosa, L. P.; Thome, Z. D. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1974. 10p. INIS.

3 figs.

The effect of double scattering on the spectator distribution is re-examined, integrating on the spectator angles and making a comparison with experimental data, for the process $K^+D \rightarrow K^+\pi^-pp$. (auth)

27521 (IC-74-117) THEORY OF PION PRODUCTION. Ballestrero, A.; Fonda, L.; Predazzi, E.; Ghirardi, G. C. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1974. 16p. INIS.

Published also in Nuovo Cim., A v. 25(3) p. 438-446(1 Feb 1975).

A new time-dependent theory for pion production in nucleon-nucleon collisions is presented, in which each production process is interpreted as a random "measurement" suffered by the nucleon-nucleon system. The approach has the advantage of being defined in a perfectly consistent way from a quantum mechanical point of view. The obtained results have a remarkable resemblance with those obtained from other models of high energy production.

27522 (MPI-PAE-EXP. EL-49) PARTIAL WAVE ANALYSIS OF THE LOW-MASS ($\pi^+\pi^-$p) SYSTEM PRODUCED IN THE REACTION pp → p($\pi^+\pi^-$p) AT 12 AND 24 GeV/c. Blobel, V.; Eskreys, A.; Fesefeldt, H.; Franz, H.; Lueers, D.; Schmitz, N.; Wagner, F.; Idschok, U.; Schroeder, B.; Kotanski, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Jun 1975. 33p. INIS.

15 figs.; 3 tabs.; 12 refs. Available from ZAED.

A partial wave analysis of the ($\pi^+\pi^-$p) system produced in the reaction pp → p($\pi^+\pi^-$p) at 12 and 24 GeV/c has been performed for ($\pi^+\pi^-$p) masses below 2 GeV, using the Illinois program. It is found that this system can be adequately described by the spin parity states $J^P = \frac{1}{2}^+$, $\frac{3}{2}^-$ and $\frac{5}{2}^+$. The two enhancements observed in the total ($\pi^+\pi^-$p) mass distribution at approximately 1,450 MeV and approximately 1,700 MeV have predominantly $J^P = \frac{3}{2}^-$. The diffractive production of the low-mass ($\pi^+\pi^-$p) system is consistent with t-channel helicity conservation. (DE)

27523 SUPERSYMMETRIC AND STRANGENESS ANALOG STATES IN *p*-SHELL Λ HYPERNUCLEI. Dalitz, R.H. (Department of Theoretical Physics, University of Oxford, Oxford, England); Gal, A. Phys. Rev. Lett. 36: No. 7, 362-365 (16 Feb 1976).

Hypernuclear ($^A_\Lambda Z$) states exist which possess higher shell-model permutation symmetry than the Pauli principle allows for nuclear ($^A Z$) states and which are the lowest hypernuclear excitations in the appropriate valent configuration. The nature and location of these supersymmetric states and of strangeness-analog states are discussed within the framework of Sakata SU(3) symmetry restricted to *p*-shell configurations, for the hypernuclei $^9_\Lambda$Be and $^{16}_\Lambda$O, for which observations have recently been reported. (auth)

27524 NUCLEON–NUCLEON INTERACTION. Brown, G. E.; Jackson, A. D. Amsterdam; North Holland Publishing Company (1976). 248p. $19.95.

The topics discussed are a general discussion of the interaction, the deuteron and low energy neutron – proton scattering, electromagnetic properties of the deuteron (interaction with radiation), proton-proton scattering, some results from scattering theory, relativistic formalism, nucleon form factors, one-boson exchange contributions to the nucleon-nucleon interaction, the two-pion exchange interaction, and construction of the potential. (JFP)

27525 THREE-BODY BOUND-STATE CALCULATION IN MOMENTUM SPACE. Gloeckle, W.; Offermann, R. (Bochum Univ., Ger.). Lett. Nuovo Cim.; 15: No. 5, 134-138(31 Jan 1976).

The determination of three-body bound and scattering states for realistic two- and three-body interactions, which are in general not separable, is still a formidable task. Since one would like to have a clear and economic algorithm to allow an easy test of various nuclear-interaction models, a previously proposed method for the calculation of bound states is considered. There is the problem of two continuous variables, for which one gains a drastic reduction in the dimensions of the problem if the p-dependence can be exhausted by a few suitably chosen basis functions taken from a complete set. Such a set is proposed which is tightly adapted to the problem under consideration. Considering a possible use for meson-theoretical nucleon–nucleon interactions the method is developed on momentum space, however, demonstrated only for three identical bosons interacting in relative s states. (JFP)

27526 p–p ($\bar{p}$–p) INTERACTIONS AT HIGH ENERGIES AND A SCALING LAW FOR THE PARTIAL CROSS SECTIONS IN $\bar{p}$–p SCATTERING. Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 15: No. 4, 115-119(24 Jan 1976).

The properties of elastic and inelastic cross sections due to the l-th partial waves, in order to examine the b dependence of the pp ($\bar{p}$p) interaction at high energy, where b is the impact parameter are discussed. A scaling law is found for these cross sections. (JFP)

27527 HIGH-p_T MESON SPECTRA AWAY FROM 90°. Kinoshita, K.; Kinoshita, Y. (Bielefeld Univ., Ger.). Lett. Nuovo Cim.; 15: No. 4, 101-106(24 Jan 1976).

The π^+/π^- and K^+/K^- ratios in pp interactions are discussed. The ratio properties of an increase with transverse momentum at fixed θ and s and with cos θ at fixed transverse momentum and s, and a decrease with s at fixed transverse momentum and θ are discussed. It is pointed out that these properties of the data can be understood in a unified way by considering two components of the distribution function given by the whole-region formula, which has been applied to various inclusive distributions on the entire Peyrou plot over PS ~ ISR energies. Emphasis is placed on the data for $p_T \geq 1.5$ GeV/c, where adjustables are almost the normalization constants of two components only. The implications of various distributions are discussed. (JFP)

27528 pp SCATTERING IN THE RANGE (20 TO 1500) GeV/c. Bartnik, E. A. (Univ., Warsaw); Namyslowski, J. M.; Din, A. M.; Rek, Z. Lett. Nuovo Cim.; 15: No. 11, 387-392(13 Mar 1976).

Calculations are presented for the reaction pp at 20 to 1500 GeV/c, showing that the factor $(-u)^{-\frac{1}{4}}$, for the ratio of real to imaginary parts of the amplitude in the forward direction, accounts for the approach of elastic scattering to geometrical scaling. It is demonstrated that with an energy-independent potential there must be uniquely associated a relative relativistic velocity $v = (-u)^{-\frac{1}{4}} m^{-1}$. (JFP)

27529 ALGEBRAIC APPROACH TO CONSTRUCTION OF TWO-α-PARTICLE INTERACTION POTENTIAL BY THE PHASE SHIFTS AT FIXED ENERGY WITH NO ABSORPTION. Malyarov, V. V.; Poplavskii, I. V.; Popushci, M. N. (Odessa Engineering-Construction Inst.). Yad. Fiz.; 22: No. 4, 860-863(Oct 1975). (In Russian)

Reconstruction is considered of two-α-particle interaction potential by the known from the phase-shift analysis data on the nuclear shift for the α-particle scattering on ^{4}He at fixed energy and with no absorption. The potentials are constructed for the energy values of 21.65, 21.80, 22.25, 22.81, 29.90 MeV (in lab. sys.). 1 figure, 1 table. (auth)

27530 MULTIPLICITY DISTRIBUTION AND SCALING AT HIGH ENERGY pp INTERACTIONS. Roy, S. R.; Bhattacharyya, D. P.; Roychowdhury, R. K.; Basu, D. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 49: No. 3, 182-197(Mar 1975).

The charged multiplicity distribution in the momentum range 28 to 1500 GeV/c in pp interactions was analyzed. A simple discrete distribution was proposed which reduces to γ distribution and exhibits K.N.O. scaling behavior at high energies. Moments of the distribution up to tenth order are computed, and they agree well with the experimental results. The calculated values of the mode, median, the first and third quartiles and the Mueller correlation parameter f_2 agree fairly well with those of the experimental distribution. The Haldane ratio of this distribution comes out to be 2.54 signifying perhaps the dominance of short range correlation. (auth)

27531 SPECTRA OF HYPERONS IN THE FRAGMENTATION REGION AND THE ONE-PION EXCHANGE REGGEIZED MODEL. Turbiner, A. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 5, 1057-1062(Nov 1975). (In Russian)

Reactions pp → ΛX and pp → $\Sigma^+(\Sigma^0)$X are considered in framework of the one-pion exchange reggeized model. It is shown that the model enables one to describe the shape and the energy dependence of the spectra. Appearance of the scaling behaviour at FNAL energies is predicted. The description is carried out in the absolute normalization. (5 figures) (auth)

27532 DOUBLE HYPERNUCLEI AND THE Λ–Λ INTERACTION. Kolesnikov, N. N.; Chernov, S. M.; Tarasov, V. I. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 33-38(1975). (In Russian)

Within the framework of a three-body model (λ + λ + nucleon core), calculations were made of the binding energy of double ($_{\Lambda\Lambda}{}^{6}$He, $_{\Lambda\Lambda}{}^{10}$Be and $_{\Lambda\Lambda}{}^{11}$Be) supernuclei, and of the binding energy of ordinary supernuclei corresponding to the above nucleons. The parameters of the Λ-Λ-interaction are found, and are compared with analogous characteristics of Λ-N-forces. (SJR)

27533 PASSAGE OF FERMIONS THROUGH A POTENTIAL BARRIER. Karpenko, I. K. (Karachaev-Cherkessk Pedogogical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 133-135(1975). (In Russian)

Recently multiple processes have been found, where the incident particle on passing through a nucleus changes its quantum numbers. It is shown that particle states can transfer to antiparticle states on passage of relativistic particles through a limited potential barrier. (SJR)

Particle Invariance Principles and Symmetries

27534 COMMENT ON "GROUP THEORY OF THE SPONTANEOUSLY BROKEN GAUGE SYMMETRIES". Elias, V.; Eliezer, S.; Swift, A. R. (Univ. of Massachusetts, Amherst). Phys. Rev., D; 12: No. 10, 3356(15 Nov 1975).

A systematic examination was previously made of the pattern of symmetry breaking in the general rotation group O(n) and unitary group SU(n). It is pointed out that in a couple of respects the discussion of SU(n) in this work is incomplete. (JFP)

General

27535 RELATIVISTIC GAP EQUATION WITH DIMENSIONAL REGULARIZATION. Lebrun, J. P. (Univ., Liege). Lett. Nuovo Cim.; 15: No. 11, 402-404(13 Mar 1976).

A representation is given for the solution of a truncated version of the Schwinger–Dyson equation. The interest in these approximate analytical solutions and their properties stems from the theory of spontaneous symmetry breaking. (JFP)

27536 APPROXIMATE SYMMETRIES AND THEIR SPONTANEOUS BREAKDOWN. Esposito, R. (Naples Univ. (Italy). Instituto di Fisica Teorica); Gallavotti, G. (Katholieke Universiteit Nijmegen (Netherlands)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 2, 159-172(1975).

A rigorous definition of approximate symmetry and of its spontaneous breakdown in connection with a phase transition is proposed. It is shown that this definition is of interest in the case of the Ising model with a small three-spin perturbation. (FR)

27537 CRITERIA OF SYMMETRY BREAKING WITH DERIVATIVES. Il'in, Yu. M. (Uzhgorod State Univ., USSR). Yad. Fiz.; 22: No. 4, 842-844(Oct 1975). (In Russian)

Two criteria of symmetry breaking with derivatives are compared. It is shown that one of the criteria (conservation of the transformation law of covariant derivatives in the symmetry breaking) reduces to exact symmetry conditions. An acceptable criterium is a choice of a definite holonomy group of the broken space. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 27451.

27538 NECESSITY FOR EXTENDED EXPERIMENTAL CONFIRMATION OF THE BREAKDOWN OF CP INVARIANCE. Pal'gi, L. (Inst. of Physics, Tallin, USSR). Yad. Fiz.; 22: No. 3, 659-660 (Sep 1975). (In Russian).

It is shown that for complete verification of the nonconversation of CP invariance it is necessary to measure charge asymmetry in the $K_L \to \pi/\nu$ decay as a function of the dependence on the strangeness of the incident beam. It is shown that the observed CP noninvariant effects can be explained in the framework of CP invariance. Therefore additional experimental work is necessary to confirm the concept of breakdown of CP invariance. (JSR)

Applications (Strong)

27539 NEW DERIVATION OF THE GELL–MANN–OKUBO MASS FORMULA. Nash, G. F. (Wadham Coll., Oxford). Lett. Nuovo Cim.; 15: No. 5, 166-168(31 Jan 1976).

Since the numbers of baryons happen to compare with the dimensions of manifolds of the group SU(3), an interaction between constituent quarks invariant under SU(3) symmetry, together with a mass-splitting component, is proposed. (JFP)

27540 DECAY OF THE psi(3.1) IN BROKEN SU_4. Kazi, A. (Univ., Hamburg); Kramer, G.; Schiller, D. H. Lett. Nuovo Cim.; 15: No. 4, 120-124(24 Jan 1976).

It was shown that the mass mixing in broken SU(4) is consistent with existing experimental information about the two-body decays of the Ψ with the exception of Ψ → $\psi_\beta\gamma$, Ψ → $\eta''\gamma$, Ψ → ηγ. (JFP)

Scattering Theory

Refer also to abstracts 27891 and 27894.

27541 (COO-2482-4) PHYSICAL OPTICS FAR FIELD INVERSE SCATTERING IN THE TIME DOMAIN. Bleistein, N. (Denver Univ., Colo. (USA)). 1976. Contract AT(11-1)-2482. 31p. Dep. NTIS $4.00.

The physical optics far field inverse scattering (POFFIS) identity relates the phase and range normalized far field back scattering amplitude to the spatial Fourier transform of the characteristic function of the scattering obstacle. The characteristic function is equal to unity in the region occupied by the obstacle and zero elsewhere. The original identity was derived by Bojarski for impulsive point sources. The result is extended to sources of arbitrary time dependence. One obtains an alternative form of Bojarski's POFFIS identity. One also derives a POFFIS identity in the time domain. Numerically synthesized checks on the method are provided. (auth)

27542 ABSOLUTELY CONTINUOUS SUBSPACE OF A SELF-ADJOINT. Gustafson, K. (Univ. of Colorado, Boulder); Johnson, G. Helv. Phys. Acta; 47: No. 2, 163-166(1974).

The absolutely continuous subspace H/sub ac/(T), an object of interest in the scattering theory of quantum mechanics and in other applications involving the spectra analysis of a self-adjoint operator T, is characterized exactly as the closure, in the given Hilbert space H, of the subspace of vectors phi satisfying the resolvent growth condition on individual vectors: parallel R/sub z/(T)phi parallel equals O(y/sup -½/), y equals Imz yields O+. (auth)

27543 CORRECTIONS TO THE GLAUBER MULTIPLE SCATTERING SERIES. Banerjee, H.; Dutta-Roy, B.; Sharma, S.K. (Saha Institute of Nuclear Physics, Calcutta-700009, India). Ann. Phys. (N.Y.) 95: No. 1, 127-138 (Nov 1975).

The asymptotic accuracy of the Glauber multiple scattering formula is examined in the fixed scatterer approximation in one dimension. If the potentials overlap, the off-shell corrections that dominate are asymptotically of the same order as the corrections to the eikonal approximation results. In the case of nonoverlapping potentials, the corrections to the Glauber formula arise from multiple scattering. The asymptotic behavior of these latter corrections depend essentially on the smoothness of the potentials. (auth)

27544 AN EFFECTIVE-POTENTIAL APPROACH TO STATIONARY SCATTERING THEORY FOR LONG-RANGE POTENTIALS. Masson, D.; Prugovečki, E. (Department of Mathematics, University of Toronto, Toronto M5S 1A1, Canada). J. Math. Phys. (N.Y.) 17: No. 3, 297-302 (Mar 1976).

It is shown that previously derived integral equations for two-body scattering with long-range potentials (equations which replace the

Lippmann-Schwinger equations) can be reduced to a form which is solvable by iterative methods. The method is applicable to potentials $V(r)$ which behave asymptotically as $r^{-\alpha}$, $1/2 < \alpha \leq 1$, and in particular to Coulomb-like potentials. (auth)

27545 ON THE EQUALITY OF *S* OPERATORS CORRESPONDING TO UNITARILY EQUIVALENT HAMILTONIANS IN SINGLE CHANNEL SCATTERING. Sáenz, A.W.; Zachary, W.W. (Naval Research Laboratory, Washington, D.C. 20375). J. Math. Phys. (N.Y.) 17: No. 3, 409-418 (Mar 1976).

Some years ago, conditions in order that unitarily equivalent Hamiltonians H and W^*HW yield the same S operator were investigated by Ekstein and by Coester and his collaborators in the framework of nonrelativistic time-dependent single-channel quantum scattering theory. This subject has turned out to be of considerable importance for nuclear physics, since it constitutes the foundation of a widely used method for constructing phase-equivalent nucleon-nucleon potentials. In the present paper we derive a rigorous and concise necessary and sufficient condition for a pair of unitarily equivalent Hamiltonians, governing the dynamics of a pair of nonrelativistic particles in the center-of-mass system, to yield the same S operator. Our theory, based on a time-dependent approach, applies to very general types of short-range potentials, with or without hard cores, and to an extensive class of long-range potentials. Our necessary and sufficient condition simplifies when certain strong limits $W_\pm$, related to W, are unitary and when $W_+ = W_-$. Requirements sufficient for each of these properties to hold are determined. Various examples of operators W such that H and W^*HW have the same S operator are discussed. (auth)

27546 QUANTUM COLLISION THEORY. Joachain, C. J. Amsterdam; North-Holland Publishing Company (1975). 721p. $89.95.

The topics discussed are a description of collision processes, potential scattering, general scattering theory, and applications. (JFP)

27547 ANALYTICAL PROPERTIES OF THE T MATRIX FOR TWO YUKAWA POTENTIALS. Tokar, S. S. (Lvov State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 54-58(1975). (In Russian).

The behavior of the residue in Regge poles of the partial T matrix on mass shells was investigated as a function of the energy E for nonrelativistic scattering on exponential and two Yukawa potentials. It was shown that the residues do not have left branch cuts in the E plane. (tr-auth)

27548 COMPLETE SET OF HYPERSPHERICAL FUNCTIONS FOR FOUR-BODY PROBLEM. Kildyushov, M. S.; Surkov, E. L. (Inst. of Atomic Energy, Moscow). Yad. Fiz.; 22: No. 3, 648-658 (Sep 1975). (In Russian).

A complete set of hyperspherical functions (k-harmonics) with given total orbital momentum L and transmutational symmetry [λ] is constructed for the four-body problem. (auth)

27549 ANGULAR MOMENTUM REDUCTION IN THE FOUR-BODY PROBLEM. Kharchenko, V. F.; Shadchin, S. A. (Inst. of Theoretical Physics, Kharkov). Yad. Fiz.; 22: No. 3, 632-647 (Sep 1975). (In Russian).

In the integral equations of motion for the four identical spinless particles with central pairing interactions the transition is made from the representation of Jacobi relative momenta to the representation of their absolute values and relative angular momenta. Then the variables related to the rotation of the system as a whole are separated in the equation. The integral equations of motion for four particles are written in the form of an infinite system of three dimensional integral equations. The four-particle kinematical factors involved in the integral kernels are expressed through kinematical factors of the three-particle type. In the case of the separable two-particle interaction the four-particle equations of motions have a form of an infinite system of two-dimensional integral equations. (auth)

27550 FEYNMAN'S ONE-DIMENSIONAL ENERGY KERNEL IN QUASICLASSICAL APPROXIMATION. Morenko, A. I.; Savel'ev, A. E. Yad. Fiz.; 22: No. 3, 609-617(Sep 1975). (In Russian).

Feynman's energy kernel $G(x,y; E)$ is obtained in the quasiclassical approximation for the case of a one-dimensional potential. It is a sum of contributions from all possible classical trajectories connecting the points x and y. In derivation of the expression for $G(x,y; E)$ the following methods were used: an analytical continuation of the Feynman propagator $K(x,y; t)$ into the lower half-plane of the complex time plane, the saddle-point method to find the Fourier transform of the propagator, and the standard technique of quasiclassical wave functions to calculate the contributions to $G(x,y; E)$ from various classical trajectories. (auth)

27551 RELATIVISTIC THREE-PARTICLE SCATTERING AMPLITUDE IN THE EIKONAL APPROXIMATION. Kvinikhidze, A. N. (Mathematical Inst., Tbilisi, USSR). Teor. Mat. Fiz.; 25: No. 3, 419-424(Dec 1975). (In Russian)

Expression for the relativistic three-particle scattering amplitude in the eikonal approximation is derived on the basis of the solution of the quasipotential type equation. All possible pair interactions as well as three-particle forces are taken into account. The expression obtained is very different from the analogous formal solution of Faddeev equations, which was used earlier for investigation of inclusive processes. (auth)

27552 NUMBER OF POSITIVE EIGENVALUES IN A CLASS OF TWO-BODY QUANTUM SYSTEMS WITH NONLOCAL INTERACTION. Zirilli, F. (New York Univ., NY). Nuovo Cim.; 31B: No. 2, 297-302(11 Feb 1976).

Using the dilatation analytic techniques recently introduced in potential scattering, an upper bound on the number of positive eigenvalues is obtained for a class of two-body quantum systems with nonlocal interactions. (auth)

27553 ON THE DUALITY OF LOCAL OBSERVABLES. Chen, E. (Rochester Univ., N. Y. (USA)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 2, 123-130(1975).

The necessary and sufficient conditions are shown for the duality, twisted duality and weak twisted duality of observable algebra and field algebra. (FR)

27554 FACTORIZATION OF THE CLASSICAL AND QUANTUM S-MATRIX AND CONSERVATION LAWS. Kulish, P. P. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 26: No. 2, 198-205(Feb 1976). (In Russian)

It is shown that the classical and quantum S-matrix can be factorized if the system possesses a complete set of the integrals of motion, which are the deformations of the free ones. The scattering characteristics of the system of N identical particles are expressed in terms of the two-body problem. (auth)

27555 MULTI-REGGE BEHAVIOR OF A CERTAIN CLASS OF DUAL RESONANCE MODELS. Frampton, P. H.; Knight, D. (Syracuse Univ., NY). Lett. Nuovo Cim.; 15: No. 4, 125-128(24 Jan 1976).

It is shown that a five-point function with S_5 invariance and which is otherwise theoretically acceptable may nevertheless violate multi-Regge asymptotic behavior. (JFP)

PHYSICS (LOW-TEMPERATURE)

Superconductivity

Refer also to abstracts 25853, 26395, 26416, 26582, 26604, 26611, 26621, 26622, 26625, 26628, 26636, 26652, 26657, 26658, 26663, 26674, 26778, 26781, 26838, 26839, and 27006.

27556 (CONF-751160-1) RADIATION EFFECTS ON SUPERCONDUCTIVITY. Brown, B. S. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 37p. Dep. NTIS $4.00.

From ASM seminar on materials science; Cincinnati, United States of America (USA) (9 Nov 1975).

The effect of radiation on the superconducting transition temperature (T/sub c/), upper critical field (H/sub c2/), and volume-pinning-force density (F/sub p/) were discussed for the three kinds of superconducting material (elements, alloys, and compounds). 11 figures, 3 tables, 86 references. (auth)

27557 DEFECT STRUCTURE OF SUPERCONDUCTORS AND THE CRITICAL CURRENT IN NON-TRANSVERSAL MAGNETIC FIELDS. Takacs, S. (Electrotechnical Inst., Bratislava). Phys. Status Solidi (a); 32: No. 2, 485-488(16 Dec 1975).

Calculating the volume pinning force in superconductors with anisotropic defect structures, a possible verification of the statistical theory of pinning is proposed. In superconductors with narrow (with respect to the coherence length) defects or defect structures in the direction perpendicular to the current ($\alpha \ll \xi$) and long enough in this direction ($A \gg \xi$), the critical current density J_c in magnetic field B should vary as $\sin^{-2}\alpha$ (α the angle between j and B). For defects or defect structures of comparable sizes with ξ ($\alpha \lesssim \xi$) this dependence changes and for $\alpha \gg \xi$ (i.e. "broader" defect structures) the critical current density follows a $\sin^{-1}\alpha$ dependence, as for isotropic defect structures (although in this case the defects should be henceforth rather anisotropic). 3 figures. (auth)

27558 STEADY-STATE PROPERTIES OF SUPERCONDUCTING BRIDGES. Likharev, K.K.; Yakobson, L.A. (Physics Department, M. V. Lomonosov Moscow State University). Sov. Phys.—Tech. Phys. 20: No. 7, 950-954 (July 1975).

The line current density J_s is calculated as a function of the phase difference φ for a superconducting bridge of "variable thickness" when the nonlinear processes are localized in the bridge. Characteristic parameters of the function $J_s(\varphi)$—the critical current J_c and the form factor $D = (dJ_s/d\varphi)^{-1}_{\varphi=\pi} Jc$—are found as functions of the bridge length. It follows from the results that variable-thickness bridges retain their Josephson properties up to lengths $\sim (2 \div 3)\ \xi$. A comparison is made with the Dayem bridge. (auth)

27559 EXISTENCE OF A MIXED "SUPERCONDUCTOR—EXCITON DIELECTRIC" PHASE IN INTRINSIC SEMIMETALS. Gabovich, A.M.; Pashitskii, É.A. (Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Phys.—Solid State 17: No. 6, 1037-1040 (June 1975).

It is shown that interband transfer processes in an intrinsic semimetal with an isotropic spectrum of electrons and holes make possible the existence of a mixed "superconductor—exciton dielectric" phase. (auth)

27560 THREE DIMENSIONAL ORDERING AND UPPER CRITICAL FIELDS FOR A SYSTEM OF WEAKLY COUPLED SUPERCONDUCTING FILAMENTS. Manneville, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). J. Phys. (Paris); 36: No. 7, 701-708(Jul 1975).

A theory for the three dimensional ordering at low temperature of a system of weakly coupled superconducting filaments is established. The phase fluctuations of the order parameter and the interaction between filaments in a mean field approximation are taken into account. T_c varies with the strength of the coupling J as $J^{\frac{1}{3}}$ in zero external magnetic field. New properties arise from the discrete character of the system. (FR)

27561 TUNNEL EFFECT. Guyon, E. (Paris-11 Univ., 91—Orsay (France)). Recherche (Paris); 6: No. 58, 618-628(Jul 1975). (In French)

It is shown that a large number of phenomena have been explained by the tunnel effect, in microscopic physics (field emission, α radioactivity) and in solid state physics (semiconductors). New applications appear everyday as in electronics and in the study of matter. (FR)

27562 PHOTOGRAPHING MAGNETIC FIELDS IN SUPERCONDUCTORS. Harrison, R. B.; Wright, L. S. (Royal Military Coll. of Canada, Kingston, Ontario). pp 276-281 of Proceedings of the 10th International Congress of Ultra-High-Speed Photography. Nice (France), September 25-30, 1972. Paget; Laviron, E. (comps). Paris, France; Association Nationale de la Recherche Technique ([nd]).

From 10th international congress of ultra-high-speed photography; Nice, France [25 Sep 1972].

Magneto-optic techniques coupled with high-speed photography are being used to study the destruction of superconductivity by a magnetic field. The phenomenon of superconductivity will be introduced with emphasis placed on the properties of type I and type II superconductors in a magnetic field. The Faraday effect and its application to the study of the penetration of magnetic fields into these superconductors will be described; the relative effectiveness of some types of paramagnetic glass will be demonstrated. A number of cinefilms will be shown to illustrate the versatility of the magneto-optic method for observing flux motion and patterns. The analysis of data obtained from a high speed film (10,200 fps) of a flux jump in Nb-Zr will be presented and discussed. (FR)

27563 SPIN SPLITTING OF THE ELECTRON STATES DENSITY OF THIN SUPERCONDUCTORS IN MAGNETIC FIELD. Vladimir, M. I.; Moskalenko, V. A. (Inst. of Applied Physics, Kishinev, USSR). Teor. Mat. Fiz.; 25: No. 2, 213-229(Nov 1975).

An analytical method of investigating the spin splitting of the electron states density of thin superconducting films placed in the parallel magnetic field is developed. The calculations are performed for a number of limiting values of the parameters of spin-orbit and spin-exchange interaction of conduction electrons with the admixture. Dependence of the spin-splitting of the density upon the admixture parameters, magnetic field and energy of elementary excitations is found. (auth)

27564 ELECTRON STATE DENSITIES OF TWO-ZONE SUPERCONDUCTOR WITH PARAMAGNET ADMIXTURE. The Case of Weak Exchange and Strong Inter-Zonal Scattering. Botoshan, N. I.; Vladimir, M. I.; Moskalenko, V. A. (Inst. of Applied Physics, Kishinev, USSR). Teor. Mat. Fiz.; 25: No. 3, 382-394 (Dec 1975). (In Russian)

It is shown that in the case of strong inter-zonal scattering of electrons on nonmagnet admixtures and moderate exchange scattering, the problem of evaluating the electron state densities in two-zone superconductors can be reduced to correspondent one-zone problem with re-determined parameters. In the case of weak exchange scattering of electrons on paramagnet admixture there is a limit transition to correspondent two-zone problem with nonmagnet admixture. The densities of states obtained are applied to the problem of evaluating the critical temperature of superconducting transition. (auth)

27565 ELECTROMECHANICAL STRESSES IN SUPERCONDUCTORS: AN ANALYSIS USING THE CRITICAL STATE MODEL. Denegri, G. B.; Molinari, G.; Viviani, A. (Univ., Genoa). Cryogenics; 15: No. 11, 649-656(Nov 1975).

An analysis of the electromagnetic stresses on a hard superconductor wire has been performed by the critical state model. A theoretical approach has been carried out by taking into account both the field produced by the current flowing in the wire and an external field orthogonal to the wire axis. Owing to analytical difficulties, mainly depending on the non-linear hysteretical feature of the field penetration, a general solution cannot be found. Nevertheless, under some restrictive conditions, an approximate solution is obtained, allowing us to compare the various force components of different origins acting on the wire. (auth)

27566 ANOMALOUS SKIN EFFECT IN METALS. II. Some Aspects of Superconductors, Sum-Rule Applications and Limits of This Technique. Drangeid, K. E.; Sommerhalder, R. (IBM Zurich Research Lab., Switzerland). Helv. Phys. Acta; 48: 609-618(1975).

Based on previous work applying to normal conducting metals, an analog network model for superconducting metals is developed. The reciprocal surface impedance associated with this model is used as a response function in connection with the Kramers-Kronig relations and the sum rule to compute electrodynamic properties of superconductors. (auth)

27567 THERMOELECTROSTATIC EFFECTS IN SUPERCONDUCTORS. Welker, N. K. Washington, DC; American Univ. (1975). 136p. University Microfilms Order No. 75-20,515.

Thesis (Ph. D.).

This experiment was undertaken in order to investigate the possible existence of a thermoelectrostatic effect in supercon-

ductors which is predicted on the basis of the two-fluid London model of superconductivity and an analogy with superfluid helium II. The phenomenon of Josephson tunneling is used as a means of detecting such an effect since any thermally generated supercurrent should produce a shift in the critical current of a Josephson point contact. Niobium was chosen as the sample because of its good mechanical properties and high predicted thermopower. Samples were prepared at ultrahigh vacuum (10^{-10} Torr) and 4.2 K to prevent surface contamination. Contrary to the results of two previous experiments, these measurements show that, within the limitations of the data collection system, no thermoelectrostatic effect exists in Nb which implies that no such effect exists in any superconductor. An upper limit more than one order of magnitude smaller than the predicted value can be placed on this effect. (Diss. Abstr. Int., B)

27568 NONEQUILIBRIUM PROPERTIES OF SUPERCONDUCTING: NORMAL METAL BOUNDARIES. Palmer, D. W. Pasadena, CA; California Inst. of Tech. (1975). 186p. University Microfilms Order No. 75-20,008.

Thesis (Ph. D.).

Three different nonequilibrium states of superconductivity were experimentally investigated. These experiments included studies of: the electron transport properties across the interface of a single superconductor and a normal metal, electron transport between two weakly coupled superconductors, and electron transport through periodic arrays of hundreds of weakly coupled superconductors. In all of these investigations most emphasis was given to quantum interference effects. All three nonequilibrium states produced time dependent voltages which were investigated both by inducing step structure on the I–V characteristics with external microwave radiation, and by directly measuring the internal oscillating potentials. Josephson's relationship between frequency and voltage, h nu equals 2 eV, was found to be significantly modified in certain well defined circumstances leading to a better understanding of quantum rules for nonequilibrium weak superconductivity. (Diss. Abstr. Int., B)

27569 SUPERCONDUCTIVITY IN SMALL METAL BRIDGES. Hannah, E. C. Princeton, NJ; Princeton Univ. (1975). 149p. University Microfilms Order No. 76-250.

Thesis (Ph. D.).

Josephson effects in weaklinks are discussed for low and high frequency regimes using simple perturbation techniques. It is proven that no measurement of the supercurrent dependence upon frequency above the Riedel peak frequency can be made using rf sources whose frequencies are below the Riedel peak. Thus the bulk of work done in the field on the high frequency structure of the Josephson current is shown to be invalid. Metal bridges shorter than a newly defined temperature independent length for superconductors, l/sub PHONON/, are proven to be identical in their Josephson current behavior to tunneling junctions. The BCS gap equation is generalized to include voltage gradient effects on pairs within the bridge. The oscillation frequency for long bridges (l/sub BRIDGE/ greater than l/sub PHONON/) is shown to be limited to less than 10" Hz. An experimental test of the new voltage dependent gap is made as well as tests of the pair reforming time of bridges. (Diss. Abstr. Int., B)

PHYSICS (NUCLEAR)

27570 (AEEW-M-1324) WIMS 69-GROUP LIBRARY TAPE 166259. Taubman, C. J. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Jul 1975. 33p. Dep. NTIS (US Sales Only) $4.50.

This note describes the contents of the WIMS 69-group library, and includes a list of nuclides with details of data file or other source of data, resonance tabulations and thermal scattering models, and a list and details of resonance tabulations. Also included are condensation spectra used to obtain group cross sections in fast energy range, group energy boundaries, and burn-up details, including fuel and fission product burn-up chains, fission product yields and energy release data. A fission spectrum for the 69-group library is given together with the λ and σp values used in the calculation of resonance cross sections, and 2200 m/sec absorption cross sections and resonance absorption integrals. (UK)

27571 (BNL-50445, pp 61-66) SEARCH FOR STABLE STRANGE NUCLEI. Schiffer, J. P. (Argonne National Lab., IL). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

Evidence for the existence of strange stable nuclei is explained. Experiments on neutron capture by collapsed or abnormal nuclei are discussed and some estimates of production of strange nuclei on the lunar surface are presented. 5 figures, 6 tables (SDF)

27572 (CEA-N-1817(Suppl.), pp 16-18) MEASUREMENT OF THE NEUTRON ELECTRIC DIPOLE MOMENT. Dress, W. B.; Perrin, P.; Miller, P. D.; Pendlebury, J. M.; Ramsey, N. F. 1975.

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin No. 7, January-June 1975. ILL experiments. (CEA Centre d'Etudes Nucleaire de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

Experiments have been performed in view of improving the accuracy in measuring the electric dipole moment of the neutron (EDM). This EDM is written as eD where e is the electron charge and D the dipole length. The analysis of the data indicates that $|D| < 3 \times 10^{24}$cm and 90% confidence. (FR)

27573 (IAEA-169(Vol. 1), pp 3v.; v. 1 p. 9-27) LIST OF COMPILATIONS, EVALUATIONS AND COMPUTER CODES OF FISSION PRODUCT NUCLEAR DATA. Valente, S. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The paper lists the compilations, evaluations and computer codes available at the time of the Fission Product Nuclear Data Panel (Bologna, November, 1973). It covers fission product yields, neutron reaction cross-sections, half lives, decay schemes, delayed neutron data and gamma-ray spectra. (auth)

27574 (IAEA-169(Vol. 1), pp 3 v.; v. 1 p. 235-283) STATUS OF NEUTRON CROSS SECTIONS OF FISSION PRODUCT NUCLIDES. Ribon, P.; Krebs, J. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The libraries of nuclear data on fission products are expected to cover some 600 to 800 F. P.'s, but the number for which a certain precision is required on the neutron reaction cross sections is less than 150. In order to clarify the needs, a classification of these F.P.'s according to the absolute precision necessary is proposed. Nearly all the requirements are for capture cross sections. A comparison of experimental or evaluated values with these precisions shows that in the thermal range our knowledge of σ_c must be improved for a dozen nuclei, while large disagreements exist for some thirty others; that the R I_c value must be improved for about ten nuclei, this value being little known for ten or so others; and that the accuracy on σ_c in the fast neutron field must be increased for some thirty nuclei, generally stable or long-lived. Comparing the values of the parameters used for calculations with the statistical model, very large divergences are observed not only for parameters such as "a", which depend on the model, but also for parameters directly deduced from experimental results.

27575 (IAEA-169(Vol. 2), pp 3 v.; v. 2 p. 53-113) INTEGRAL DETERMINATION OF NEUTRON ABSORPTION BY FISSION PRODUCTS. Bustraan, M. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The techniques for integral measurements of fission product capture cross sections are outlined. The presently performed experiments are discussed and the results obtained up to now are critically reviewed. (auth)

27576 (IAEA-169(Vol. 3), pp 3 v.; v. 3 p. 143-161) COMPILATION OF NEUTRON CAPTURE CROSS SECTION DATA FOR FISSION PRODUCT NUCLIDES IN THE ENERGY RANGE FROM 1 keV TO 15 MeV. Matsunobu, H. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Nuclear data of the fission products play an important role in many fields relating to nuclear energy. In particular, neutron capture cross section of the fission product nuclides is an important quantity in order to determine reactor design and burn up of nuclear fuel. However, the situation of the data for neutron capture cross section is not satisfactory at present. In this paper, status of the experimental data for neutron capture cross section which were compiled up to date for the important 28 nuclides in the energy range from 1 keV to 15 MeV is explained, and comparisons with the evaluated data are given. Furthermore, measurememnts of neutron capture cross section are requested for the important nuclides whose experimental data are not obtained or poor. (auth)

27577 (IAEA-169(Vol. 3), pp 3 v.; v. 3 p. 339-364) EVALUATIONS PERFORMED FOR THE SGAE FISSION PRODUCT NUCLEAR DATA FILE. Lammer, M. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

A brief description of the SGAE fission product nuclear data file was given in a previous paper and recommended data tabulated without details. This paper describes how the evaluation of half lives, γ-ray energies and absolute intensities and decay branching ratios was performed. References used for these data are listed and individual evaluations of half lives and branching ratios are tabulated together with the experimental data used. (auth)

27578 (LA-5961) ELECTRON ELASTIC SCATTERING CROSS SECTIONS FROM 1 keV TO 100 MeV FOR ELEMENTS Z EQUALS 1 TO 100. Storm, E.; Hancock, J. H. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1975. Contract W-7405-Eng-36. 311p. Dep. NTIS $10.75.

Tables of electron elastic scattering differential cross sections of elements (Z equals 1 to 100) are given for electron energies in the range of 1 keV to 100 MeV and scattering angles in the range of 1 to 179°. The function describing the asymmetry of a polarized electron beam after the scattering process is also included in the tables. (auth)

27579 ANALYSIS OF BENCHMARK EXPERIMENTS FOR TESTING THE IKE MULTIGROUP CROSS-SECTION LIBRARIES BASED ON ENDF/B-III AND IV. Keinert, J.; Mattes, M. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 174-180(1975).

8 figs.; 13 tabs.; 17 refs.

Benchmark experiments offer the most direct method for validation of nuclear cross section sets and calculational methods. For 16 fast and thermal critical assemblies containing uranium and/or plutonium of different compositions calculational results were compared with measured integral quantities, such as k_{eff}, central reaction rate ratios or fast and thermal activation (dis) advantage factors. Because of the simple calculational modelling of these assemblies the calculations proved as a good test for the IKE multigroup cross section libraries essentially based on ENDF/B-IV. In general, calculational results are in excellent agreement with the measured values. Only with some critical systems the basic ENDF/B-IV data proved to be insufficient in calculating k_{eff}, probably due to Pu neutron data and U 238 fast capture cross sections. (DE)

Neutron Interactions with Matter

Refer also to abstracts 27570 and 28038.

27580 (AED-CONF-75-404-008) INVESTIGATION OF THE NEUTRON TEMPERATURE DEPENDENCE OF THE EFFECTIVE CROSS SECTION, AND THE DETERMINATION OF CROSS SECTIONS FOR "NON"-1/v ABSORBERS. Gryntakis, E. M.; Kim, J. I. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Radiochemie). 1975. 7p. (In German). INIS.

From general meeting of the Gesellschaft Deutscher Chemiker; Koeln, F. R. Germany (8 Sep 1975).

6 figs.

The g(Tn) functions are calculated for the most important "non"-1/v absorbers in the neutron temperature region of 0°C to 2,000°C. The neutron temperature of various irradiation positions of the research reactor Munich is measured using the g(Tn) function of ^{176}Lu and the activation method. A method is developed requiring no Cd filters for nuclides where the normal Cd method to determine the resonance integral cannot be used. (DE)

27581 (ORNL/TM-5224) ITERATIVE SOLUTION OF THE DIFFUSION AND P_1 FINITE ELEMENT EQUATIONS. Tomlinson, E. T.; Robinson, J. C.; Vondy, D. R. (Oak Ridge National Lab., Tenn. (USA)). Feb. 1976. Contract W-7405-eng-26. 97p. Dep. NTIS $6.50.

Thesis. Submitted to the University of Tennessee, Knoxville.

A method for obtaining solutions to the time-independent Boltzmann neutron transport equation on triangular grids with non-orthogonal boundaries and anisotropic scattering is developed. A functional is obtained from the canonical form of the multigroup transport equation. The angular variable is then removed by expanding the functional in spherical harmonics, retaining only the first two moments and limiting the anisotropic scattering to be linear. The finite element method is then implemented by using quadratic Lagrange-type interpolating polynomials to span the spatial domain. The resultant set of coupled linear equations is then solved iteratively. The applicability of convergence acceleration techniques developed for the finite difference method is tested and implemented where appropriate. Finally, a number of numerical experiments are performed to evaluate the performance of the proposed method. The results are compared to results obtained by various established methods. In all cases, agreement is excellent. 16 figures, 7 tables. (auth)

27582 MACROSCOPIC EQUATION FOR NEUTRON SLOWING-DOWN IN GEOLOGICAL MEDIA. Kozachok, I. A. (Inst. of Geophysics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 12, 1071-1075(1975). (In Russian)

On the basis of the spherical harmonics P_2 approximation and a quasi-hydrogeneous model, a new macroscopic equation is obtained which describes a nonstationary neutron slowing-down in a multielement medium of arbitrary composition. The corresponding boundary conditions are formulated. (auth)

27583 NEUTRON SLOWING DOWN WITH ENERGY-DEPENDENT ANISOTROPY OF SCATTERING. Stefanovic, D. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Nucl. Sci. Eng.; 59: No. 2, 194-198(Feb 1976).

The problem of neutron slowing down in an infinite medium with energy-dependent anisotropy of elastic scattering has been discussed. The scattering function, P(u', DELTA mu), is redefined and expanded in terms of Legendre polynomials and the energy-dependent coefficients of the expansion are determined; in this expansion of P(u', DELTA u) it is possible to carry out matrix degeneration of the kernel of the slowing-down equation; the matrix separable kernel allows the transformation of the integral equation into a differential equation in terms of Green's slowing-down functions. In some cases it is possible to obtain analytically the Green's slowing-down functions. In general, these functions are determined by standard numerical methods for solving sets of differential equations. 4 figures. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 27356 and 27520.

27584 (CEA-N-1817(Suppl.), pp 14-16) STUDY OF THE n,p (2γ) RADIATIVE CAPTURE. Guet, C.; Dress, W. B.; Perrin, P. 1975. (In French)

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin No. 7, January-June 1975. ILL experiments. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

A tentative explanation for the differences between the experimental and theoretical values of the n,p capture cross section is presented involving the possibility of an anomalous transition $^3S_1$-$^3S_1$ leading to two photons whose energy sum is that of the 2.2 MeV excited level in deuterium. A crest centered on the kinematic contour at 2.2 MeV was effectively observed. A comparison with the spectrum obtained for a D_2O target shows that these events are due to hydrogen. (FR)

27585 (INIS-mf-1826) PION-EXCHANGE CONTRIBUTIONS TO THE (γ,p) REACTION ON DEUTERIUM AND HELIUM NUCLEI AT MEDIUM ENERGY. Finjord, J. (Trondheim Univ. (Norway). Norges Laererhoegskole). Feb 1974. 118p. INIS.

The formalism for computation of pion-exchange contributions to the (γ,p) two-body photodisintegration of d, ^3He, and ^4He nuclei is developed. Fermi motion effects are included since the nuclear wave functions are written as Fourier integrals over momentum space. The CGLN photoproduction amplitude and a pseudoscalar nNN interaction are used at the vertices; Ferrari–Selleri's form factor is used to modify the propagator and vertices for off-shell effects. A review of the currently used wave functions for the nuclei considered is presented. Final-state interactions between the proton and the final nucleus are not considered. The electromagnetic interaction is considered in an Appendix. Numerical results for Hulthen deuteron wave functions and Irving or Jain–Srivastava helium wave functions are presented; only the symmetric S nuclear states are taken into consideration, and the energy prescription is essentially on-shell; E_γ is between 165 and 330 MeV. A Frascati experiment exhibits a top in the $\frac{d\sigma}{d\Omega}$90°CMS for ^4He at ~260 MeV, while a Saclay experiment shows monotonously decreasing curves for both helium nuclei in the medium energy range. The calculations support the qualitative features of the latter experiment; the effect of the N resonance is found to be less important than in the speculations of the Frascati group. The results depend strongly on the choice of wave functions, so that the quantitative importance of the approximations cannot be stated exactly. The pion exchange seems to give the dominant contribution in the medium energy range, however. (auth)

27586 (INIS-mf-1865) STUDY ON THE THREE-NUCLEON REACTION H(d,pp)n AT 12.9 MeV. Schram, P. H. (Vrije Universiteit, Amsterdam (Netherlands)). Jun 1975. 79p. INIS.

38 ref., 26 figs., 5 tables.

Kinematically complete experiments in which both the outgoing protons of the reaction H(d,pp)n are detected coincidently are discussed. (INIS)

27587 COMPOSITE NUCLEON APPROACH TO THE DEUTERON PROBLEM. Agarwal, B.K. (International Centre for Theoretical Physics, Trieste, Italy). Ann. Phys. (N.Y.) 95: No. 1, 112-126 (Nov 1975).

A composite model is suggested for the nucleons by assuming a long range strong gluon force between a diquark boson *B* and a quark *A*. In the proton, *A* is trapped inside *B* in an oscillator potential and, in the neutron, *A* is on the surface of *B* in a hydrogenlike state. Nucleon form factors are obtained in agreement with experiments. The model contains a mechanism for a large effective mass of the quark *A*. When *B* is identified with π and *A* with μ, one can fix the gluon charge value and obtain the magnetic moments of the proton and neutron. The ($\mu\pi$) atomic model for the nucleon can be used to construct the deuteron on a hydrogen molecule model. It leads to values for the binding energy, electric quadrupole moment, and form factors of the deuteron that are in agreement with experiments. (auth)

27588 TOTAL CROSS SECTION RESULTS FOR DEUTERIUM ELECTRODISINTEGRATION. Skopik, D.M.; Murphy, J.J. II; Shin, Y.M. (Saskatchewan Accelerator Laboratory, University of Saskatchewan, Saskatoon, Canada S7N OWO). Phys. Rev. C 13: No. 1, 437-438 (Jan 1976).

Theoretical total cross sections for deuterium electrodisintegration are presented as a function of incident electron energy. The cross section has been calculated using virtual photon theory with Partovi's photodisintegration calculation for $E_x > 10$ MeV and effective range theory for $E_x < 10$ MeV. Experimental electrodisintegration cross sections integrated over limited ranges of energies have been deduced from some previously reported measurements. Satisfactory agreement is found between experiment and theory. These results are of interest not only for checking virtual photon theory but also in estimating neutron fluxes arising from the $^2H(e, n)$ reaction in Tokamak reactors. (auth)

27589 RELATIVISTIC THREE-BODY CALCULATION OF πd SCATTERING. Woloshyn, R.M.; Moniz, E.J. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of

Technology, Cambridge, Massachusetts 02139); Aaron, R. Phys. Rev. C 13: No. 1, 286-298 (Jan 1976).

We present a unitary, Lorentz-invariant three-body calculation of pion-deuteron elastic scattering, based upon the idea of quasiparticle-dominated two-body interactions. We make detailed comparisons of three results with those of a conventional fixed-scatterer approach and find that the fixed-nucleon calculation does not adequately reproduce the three-body results, demonstrating the importance of properly treating the three-body kinematics (i.e., of including nucleon recoil and isobar propagation). The multiple scattering expansion converges much more rapidly in the three-body approach than in the fixed-scatterer calculation. Intermediate nucleon-nucleon interactions play an important role, giving contributions to the scattering amplitude of the same order as those given by pion multiple scattering; these effects are especially significant for back-angle scattering. Finally, we compare our results with the available experimental data for the πd total and integrated elastic cross sections and obtain good agreement. Nucleon spin is neglected in all calculations. (auth)

27590 (*p*,2*p*) AND (*p*,*pd*) REACTIONS ON ^{3}H AT 45.6 MeV. Bonbright, D.I.; Elbakr, S.A.; Houdayer, A.; Miller, C.A.; Roberts, D.J.; Tin, E.S.Y.; van Oers, W.T.H.; Watson, J.W. (Cyclotron Laboratory, Department of Physics, University of Manitoba, Winnipeg, Canada R3T 2N2). Phys. Rev. C 13: No. 1, 68-79 (Jan 1976).

The reactions ^{3}H(*p*,2*p*) *nn*, ^{3}H(*p*,*pd*) *n*, and ^{3}He(*p*,2*p*) *d*, ^{3}He(*p*,2*p*) *pn*, and ^{3}He(*p*,*pd*) *p* have been studied at 45.6 and 45.0 MeV, respectively, using coplanar symmetric and asymmetric geometries. An angular correlation has been obtained for the ^{3}H(*p*,2*p*) [*nn*] reaction, where [*nn*] denotes an *n*-*n* pair with low energy for its relative motion. Energy sharing data for this reaction have also been obtained at a number of coplanar asymmetric angle pairs which allow zero spectator momentum. Within the framework of the plane wave impulse approximation the extracted momentum distributions of the $p+[nn]$ system in ^{3}H and the $p+d$ and $p+d^*$ systems in ^{3}He are compared with predictions calculated using relatively simple wave functions for ^{3}H, ^{3}He, *d*, d^*, and [*nn*]. Reasonable agreement between the shapes of the extracted and theoretical momentum distributions has been obtained, but there exist differences between the momentum distributions extracted from the angular correlation and energy sharing data. The ^{3}H(*p*,*pd*) quasifree scattering enhancements exhibit shifts in the peak position away from the minimum in the momentum of the spectator neutron. Comparison of the four-body continua of the ^{3}H(*p*,2*p*) *nn* reactions reveals enhancements which can be interpreted as due to pseudo-two-body processes, namely, the p-d^* quasifree scattering process and the reaction $p+{}^3\mathrm{H}\rightarrow d^*+d^*$. (auth)

27591 ^{3}H(*p*,2*p*) *n* REACTION AT 23 MeV UNDER THE CONDITION OF COLLINEARITY OF THE FINAL STATE PARTICLES IN THE CENTER-OF-MASS SYSTEM. Lambert, J.M.; Treado, P.A. (Georgetown University, Washington, D.C. 20007); Allas, R.G.; Beach, L.A.; Bondelid, R.O.; Diener, E.M. Phys. Rev. C 13: No. 1, 43-45 (Jan 1976).

The ^{2}H(*p*,2*p*) *n* reaction has been investigated under the special kinematic condition that the neutron is at rest in the center of mass. A comparison of experiment and theory is used to examine the significance of the spectral structure observed for such collinearity conditions. (auth)

27592 INTEGRAL RELATION FOR THE ASYMPTOTIC NORMALIZATION OF THE TRITON. Lehman, D.R. (Department of Physics, The George Washington University, Washington, D.C. 20052); Gibson, B.F. Phys. Rev. C 13: No. 1, 35-37 (Jan 1976).

An integral relation is derived for the asymptotic normalization constant of the neutron-deuteron tail in the triton wave function. The formula resembles integrals employed in obtaining the triton wave function and it should be particularly useful for calculating the asymptotic normalization of wave functions obtained from local potentials. (auth)

27593 NONCOHERENT PHOTOPRODUCTION OF $\pi^\pm$ MESONS ON NUCLEI AT THE PHOTON ENERGY OF 2 GeV. Abramyan, L. O.; Aganyants, A. O.; Vartapetyan, G. A.; Gevorkyan, S. R.; Khudaverdyan, A. G. (Erevan Physical Inst.). Yad. Fiz.; 22: No. 3, 520-524(Sep 1975). (In Russian).

Cross sections of the $\gamma A \rightarrow \pi^\pm A'$ reactions on nuclei $H_2(CH_2-C)$, C, Al, Cu, Ag, and Pb are measured at the photon energy $E_\gamma = 2$ GeV and $|t| = 0.3$ and 0.58 $(GeV/c)^2$. The obtained values of Z_{eff} at $|t| = 0.58$ $(GeV/c)^2$ are in agreement with predictions of model of the meson noncoherent photoproduction on nuclei, while in case $|t| = 0.3$ $(GeV/c)^2$ the obtained values of Z_{eff} are less than the corresponding theoretical estimates. The ratios π^-/π^+ for the nuclei C and Pb coincide with the available data at $E_\gamma = 3$ GeV. (auth)

27594 MULTIPARTICLE REACTIONS OF PION ABSORPTION BY LIGHT NUCLEI. Kosmach, V. F.; Martirosova, A. G.; Ostroumov, V. I. (Leningrad Polytechnical Inst.). Yad. Fiz.; 22: No. 3, 453-458(Sep 1975). (In Russian).

An identification of various channels of 112-MeV positive pion absorption by light photoemulsion nuclei is carried out. Energy characteristics and angular correlations of emitted particles are analyzed, and an attempt is made to select the events of pion absorption by various nuclear substructures. The π^+ meson absorption by a quasideuteron is essential (~70%). (auth)

27595 ESTIMATION OF ELECTRIC DIPOLE CROSS SECTIONS FOR THE REACTION ^{4}He(γ,p)^{3}H. Gur'ev, V. N. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 12, 1993-1997(Dec 1975). (In Russian)

Calculations were made for the total electric dipole cross sections of the reaction ^{4}He(γ,p)^{3}H at photon energies E_γ from the reaction threshold to 70 MeV and for the isotropic contribution to the photoproton angular distribution at $E_\gamma \leq 35$ MeV under the two-level resonance approximation for isovector E1-amplitudes with $s = 0$ and 1 two-particle unitarity consequences being taken into account. A satisfactory agreement with the experimental data is obtained in the giant resonance region in the assumption of the dominating contribution of the $(^1P_1)$-configuration in the upper resonance state $J^\pi(T) = 1^-$ (1) of the ^{4}He nucleus. (auth)

27596 SECONDARY RESCATTERING IN THE REACTION D(π^-,π^-p)n AT HIGH ENERGIES. Kolybasov, V. M.; Ksenzov, V. G. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 4, 720-729(Oct 1975). (In Russian)

Theoretical investigation of the reaction D(π^-,π^-p)n is fulfilled, taking into account, besides the simple quasielastic knock-out, the graphs describing the secondary rescatterings of the reaction products. The momentum and polar-angle distributions for the neutron, as well as the distributions in the Treiman–Yang angle, are compared with the experimental data at the energy of 1 GeV. Character of various distributions, due to particular graphs, and their sensibility to the reaction mechanism are studied. 6 figures. (auth)

27597 EXCITED STATES OF ^{4}He NUCLEUS OBSERVED IN REACTIONS (^{6}Li,α) AND (^{3}He,p). Glukhov, Yu. A.; Novatskii, B. G.; Ogloblin, A. A.; Sakuta, S. B.; Stepanov, D. N.; Chuev, V. I. (Inst. of Atomic Energy, Moscow). Yad. Fiz.; 22: No. 4, 679-686(Oct 1975). (In Russian)

Reactions D(^{6}Li,α) and D(^{3}He,p) have been studied at the ^{6}Li-ion energies of 30.5 and 32.5 MeV and at several energies of ^{3}He ions in the interval from 12 up to 30 MeV. Spectra of the emitted particles were measured in the region of small angles. In the reaction (^{6}Li,α) intensive groups of α particles corresponding to the known levels of ^{4}He, 21.2 MeV (0^-) and 22.1 MeV (2^-), and to a new level with the excitation energy of 27.1 MeV were observed. The ground state and the first excited level 0^+ (20.1 MeV) of the ^{4}He nucleus were produced with cross sections that are less by several dozen times. Analyzing the excitation probabilities for various levels of ^{4}He in reactions (^{6}Li,α) and (^{3}He,p), as well as cross sections of the reaction ^{3}He(^{6}Li,α)^{5}Li, producing the known deuteron threshold state of ^{5}Li(16.7 MeV), one concludes that the levels of 21.2, 22.1, and 27.1 MeV of the ^{4}He nucleus are generated in the (^{6}Li,α) reaction by means of the deuteron transfer and, consequently, they have a considerable admixture of the two-particle configuration. 4 figures, 1 table. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 27356, 27385, 27393, 27523, 27593, 27594, 27631, 27633, 27662, 27756, 27781, and 27782.

27598 (INR-1474/1/PL/A) ANALYSIS OF THE ^{9}Be(d,α_0)^{7}Li$_{g.s.}$ AND ^{9}Be(d,α)^{7}Li*(470 keV) REACTIONS IN TERMS OF THE TWO-NUCLEON DISTORTED WAVE BORN APPROXIMATION. Saganek, A.; Sledzinska, I.; Zwieglinska, B. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 31p. INIS.

Absolute differential and total cross sections for the ^{9}Be(d,α)^{7}Li reactions leading to the ground and first excited (470 keV) states have been measured for bombarding energies of 2.25 to 3.1 MeV. An analysis of these reactions for energies of 0.9 to 3.1 MeV has been performed in terms of distorted wave Born approximation for two-nucleon transfer. (auth)

27599 (IPNO-T-75-05) INELASTIC SCATTERING OF MEDIUM ENERGY PARTICLES ON ^{16}O. Chretien-Duhamel, G. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire; Paris-11 Univ., 91–Orsay (France)). 1975. 90p. (In French). INIS.

The inelastic scattering of 156 MeV protons, 80 MeV deuterons and 165 MeV alphas has been studied on oxygen 16. The scattered particles were detected by a proportional wire chamber normal to the optical axis of the magnet, in coincidence with a telescope

of two plastic scintillators. The inelastic scattering cross-sections were measured for 14 levels under 14 MeV excitation energy for deuterons, and 9 levels or groups for protons between 5° and 38° laboratory. Angular distributions were analyzed for the 3 first collective levels in the framework of macroscopic model and DWBA calculations, and corresponding deformation parameters extracted. The second part of this work is centered on the microscopic interpretation of the results and on the detailed study of the central part of effective deuteron-nucleon interaction as well as its different components. The good effective interaction has been chosen to reproduce the angular distribution of the 3^- level at 6.13 MeV, and used to analyze those of the negative parity levels. A microscopic analysis of the (p,p') results was made on the same levels in the framework of the impulse approximation. (FR)

27600 $^{14}C(d,t)^{13}C$ REACTION-CROSS-SECTION AND ANALYZING-POWER MEASUREMENTS AT 14 MeV. Weller, H.R.; Blue, R.A. (Department of Physics, University of Florida, Gainesville, Florida 32601); Darden, S.E.; Yoh, W.A. Phys. Rev. C 13: No. 1, 38-42 (Jan 1976).

Cross-section and vector-analyzing-power measurements have been performed for the $^{14}C(d,t)^{13}C$ reaction leading to the ground and first three excited states of ^{13}C. A 14 MeV vector-polarized beam was employed for the measurements. Distorted-wave Born-approximation calculations agree reasonably well with the data. The results suggest a 2p-2h admixture of a $(d_{5/2}{}^2, sp^{-2})_n$ configuration having an intensity of 4% and a $(2s_{1/2}{}^2, sp^{-2})_n$ configuration with an intensity of 3% in the ground state of ^{14}C. (auth)

27601 LONG-LIVED STATES AT HIGH EXCITATION ENERGIES IN ^9Be AND ^{10}B. Ajzenberg-Selove, F. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Maguire, C.F.; Hendrie, D.L.; Scott, D.K.; Mahoney, J. Phys. Rev. C 13: No. 1, 46-49 (Jan 1976).

A study of highly excited states in ^9Be and ^{10}B has been conducted using the $^9Be(He,\alpha)$ and $^{11}B(^3He,\alpha)$ reactions at E (^3He) = 49.3 MeV and the Berkeley magnetic spectrometer. We observe three new states in ^9Be at $E_x = 22.05$, 22.63, and 22.98 MeV (±0.1 MeV) with $\Gamma_{c.m.} < 0.3$ MeV. In ^{10}B we confirm the previously known states $^{10}B^*$ (10.85, 11.52, 12.56) and report a new state $^{10}B^*$ (13.49) with $\Gamma_{c.m.} = 0.3$ MeV, in addition to two broader states. Comparisons are made with the analog regions in ^9Li and ^{10}Be. (auth)

27602 MASS OF ^8C. Tribble, R.E.; Kenefick, R.A.; Spross, R.L. (Cyclotron Institute, Texas A&M University, College Station, Texas 77843). Phys. Rev. C 13: No. 1, 50-54 (Jan 1976).

A new determination of the mass excess of ^8C by the $^{12}C(^4He,^8He)^8C$ reaction has yielded a value of 35.10 ± 0.03 MeV. The new value is in good agreement with the quadratic isobaric multiplet mass equation prediction. Higher order cubic and quartic mass equation coefficients are found to be small for the $A = 8$ isobaric quintet. (auth)

27603 INVESTIGATION OF THE $(d_{5/2})^2$ AND $(d_{5/2}s_{1/2})$ TWO-PARTICLE CONFIGURATIONS IN ^{18}O USING THE $^{17}O(d,p)^{18}O$ REACTION AT 18 MeV. Li, T.K.; Dehnhard, D.; Brown, R.E.; Ellis, P.J. (School of Physics, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. C 13: No. 1, 55-67 (Jan 1976).

Differential cross sections of deuteron elastic scattering from ^{17}O and of the $^{17}O(d,p)^{18}O$ reaction have been measured at a deuteron bombarding energy of 18 MeV for transitions to 12 states in ^{18}O up to an excitation energy of 6.341 MeV. Absolute spectroscopic factors were extracted with the aid of distorted-wave-Born-approximation calculations. The results are compared with theoretical calculations and show a distinct preference for a weak-coupling model. Diagonal matrix elements of the effective neutron-neutron interaction were deduced from the data for the $(d_{5/2})^2_{0+,2+,4+}$ and $(d_{5/2}s_{1/2})_{2+,3+}$ configurations. A theoretical estimate of the errors involved is in qualitative agreement with the deviations observed between experiment and theory. (auth)

27604 ^9Be PRODUCING REACTIONS IN $^{12}C + {}^{12}C$, $^{16}O + {}^{16}O$, AND $^{28}Si + {}^{12}C$. Artz, J.L.; Greenfield, M.B.; Fletcher, N.R. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 13: No. 1, 156-163 (Jan 1976).

The $^{12}C(^{12}C, ^9Be)$, $^{16}O(^{16}O, ^9Be)$, and $^{28}Si(^{12}C, ^9Be)$ reactions show final state relative populations which are very similar to the corresponding (^6Li, d), (^7Li, t), (^{12}C, α), and (^{16}O, ^{12}C) reactions on the same target nuclei. Selective population of final states for ^{12}C and ^{28}Si targets is accompanied by rapidly fluctuating excitations for the $^{12}C(^{12}C, ^9Be)$ reactions and much smoother, yet not flat, excitation functions for $^{28}Si(^{12}C, ^9Be)$. Angular distributions are forward peaked. The $^{16}O(^{16}O, ^9Be)$ reaction is not selective, similar to $^{16}O(^{12}C, \alpha)$. (auth)

27605 $^{12}C(p,pn)^{11}C$ CROSS SECTION AT 300 GeV. Kaufman, S.B.; Weisfield, M.W.; Wilkins, B.D.; Henderson, D.; Steinberg, E.P. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 13: No. 1, 253-256 (Jan 1976).

The absolute cross section for the $^{12}C(p,pn)^{11}C$ reaction has been measured in the $M2$ diffracted proton beam of the Fermi National Accelerator Laboratory at an energy of 300 GeV. Proton intensities were measured with a scintillation counter telescope, and the 20.4-min ^{11}C activity induced in 3.2-mm thick plastic scintillator targets was determined both by internal scintillation (β) counting and by annihilation radiation counting with a NaI well crystal. A correction for the formation of ^{11}C by secondary particles was determined by measuring the activity in individual targets in a stack. The corrected value for the $^{12}C(p,pn)^{11}C$ cross section at 300 GeV is 24.6 ± 1.6 mb. (auth)

27606 EFFECTS ON LOW-ENERGY PHENOMENA OF SOME RECENT RESULTS OBTAINED IN HIGH-ENERGY PHYSICS. Logan, B.A. (Department of Physics, University of Ottawa, Ontario, Canada); Ljubičić, A. Phys. Rev. C 13: No. 1, 361-366 (Jan 1976).

Two of the more interesting results obtained recently in high-energy physics have been the observation of neutral current phenomena in weak interactions and the possible existence of a light scalar boson as suggested by discrepancies in the x-ray energies of muonic atoms. Some phenomena in low-energy physics can be effected by the possible consequences of these high-energy results. The effects, and possible experimental arrangements by which they can be investigated, are discussed and analyzed. (auth)

27607 "RESONANCES" IN $^{12}C(^{12}C,\alpha)^{20}Ne$ AND $^{12}C(^{13}C,^9Be)^{16}O$ REACTIONS AT ABOUT 37 MeV. Eberhard, K.A.; Bernhardt, K.G. (Nuclear Physics Laboratory, University of Washington, Seattle, Washington 98195). Phys. Rev. C 13: No. 1, 440-443 (Jan 1976).

Angular distributions and excitation functions for $^{12}C(^{12}C,\alpha)^{20}Ne$ and $^{12}C(^{12}C,^9Be)^{16}O$ have been measured around $E_{^{12}C}$(c.m.) = 18.5 MeV, where strongly correlated structure for both reactions has been reported. Both ground-state angular distributions are dominated by a single angular momentum; for $^{12}C(^{12}C,\alpha)^{20}Ne_{g.s.}$ the dominant angular momentum is $l = 10$, while for $^{12}C(^{12}C, ^9Be_{g.s.})^{16}O_{g.s.}$ it is $l = 12$. Hauser-Feshbach calculations reproduce the shapes of the angular distributions; the dominant angular momenta are the grazing partial waves in the outgoing channels. (auth)

27608 MICROSCOPIC EFFECTIVE INTERACTION FOR 155-MeV PROTONS. Buenerd, M. (Institut des Sciences Nucléaires, B.P. 257, Centre de Tri, 38044-Grenoble Cedex, France). Phys. Rev. C 13: No. 1, 444-446 (Jan 1976).

An empirical nucleon-nucleon effective interaction is derived by fitting the angular distributions of various (J^π, T) transitions from the $^{12}C(p,p')^{12}C^*$ reaction. (auth)

27609 $^{12}C(^{16}O,^{12}C)^{16}O^*$ INELASTIC SCATTERING IN THE REGION OF THE $E_{c.m.} = 19.7$ MeV RESONANCE. Sperr, P.; Henning, W.; Erskine, J.R. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 13: No. 1, 447-449 (Jan 1976).

Excitation functions and angular distributions have been measured with high resolution for inelastic scattering to the 0^+ 6.050-MeV, 3^- 6.131-MeV, 2^+ 6.919-MeV, and 1^- 7.119-MeV states in ^{16}O near the $E_{c.m.} = 19.7$-MeV resonance in the $^{12}C + {}^{16}O$ system. The 0^+ and 2^+ states show no resonant behavior whereas the 3^- state does. These results do not support an explanation for the $E_{c.m.} = 19.7$-MeV resonance which involves an α-particle exchange mechanism. (auth)

27610 THE UNRESOLVED (π, πN) PUZZLE. Karol, P.J. (Department of Chemistry, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). Phys. Rev. Lett. 36: No. 6, 338-339 (9 Feb 1976).

The importance of charge-exchange interactions of nucleons within the nucleus following (π, πN) reactions as proposed recently by Sternheim and Silbar may be quantitatively appraised. An experiment datum already exists which contradicts the hypothesis that charge exchange is so influential. (auth)

27611 ANOMALOUS ANGULAR DISTRIBUTION IN THE TRANSITION TO THE $2s_{1/2}$ STATE IN ^{17}O. Motobayashi, T.; Kohno, I.; Katori, K.; Yoshie, M.; Ohi, T.; Kamitsubo, H. (The Institute of Physical and Chemical Research, Wako-shi, Saitama 351, Japan). Phys. Rev. Lett. 36: No. 7, 390-392 (16 Feb 1976).

The reaction $^{16}O(^{14}N, ^{13}N)^{17}O$ has been studied at a bombarding energy of 79 MeV. The angular distribution for the transition to the $2s_{1/2}$ state in ^{17} showed an anomaly similar to that already reported in studies of $^{12}C(^{14}N, ^{13}N)^{13}C$ and $^{12}C(^{10}B, ^9Be)^{13}N$. (auth)

27612 TRACK STUDIES OF INTERACTION PRODUCTS OF ^{40}Ar IONS WITH C, F, AND Al NUCLEI. Kashkarov, L. L.; Lavrukhina, A. K.; Malyshev, V. V.; Satarova, L. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Bull. Acad. Sci. USSR, Phys. Ser.; 34: No. 10, 1877-1880(Oct 1970).

From 20th annual conference on nuclear spectroscopy and nuclear structure; Leningrad, USSR (28 Jan 1970). Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: No. 10, 2105-2108(Oct 1970).

Measurements are reported of lengths of tracks produced in

solid track detectors by products of the interaction of 220 MeV $^{40}Ar^{6+}$ ions with the target elements C, F, and Al. (auth)

27613 CHARACTERISTICS OF NEUTRONS FROM THICK TARGETS BOMBARDED BY DEUTERONS AT 23 MeV. Narziev, Kh. (Tadzhik State Univ., Stalinabad, USSR). Dokl. Akad. Nauk Tadzh. SSR; 18: No. 5, 23-26(1975). (In Russian).

The secondary radiation produced by thick targets irradiated by 23-MeV deuterons was measured. The results can be used for the calculation of construction and protection assemblies subjected to irradiation by charged particles at energies at which the secondary radiation can give a significant contribution to the dose behind the shield. In spectra measured at an angle of $\theta = 0^0$ to 135^0 the contribution of processes which can be attributed to direct processes is quite large. From the measurements made it is seen that a very low output was observed in Ni and Pb targets. Be, Al, Ag, Nb, Ta, and U targets were also studied. (JSR)

27614 INVERSE MAXIMA IN THE REACTION (α,d) ON THE NUCLEI ^{9}Be AND ^{10,11}B. Vasil'eva, O. I.; Lebedev, V. M.; Spasskii, A. V.; Tepel, I. B.; Fateeva, L. N. (Moscow State Univ.). Yad. Fiz.; 22: No. 3, 446-452(Sep 1975). (In Russian).

Measured angular distributions of deuterons from the (α,d) reactions on nuclei ^{9}Be and ^{10,11}B up to the angle $\theta_{Lab} = 170°$ are presented for the α-particle energies from 15 up to 25 MeV. The differential excitation curves for these reactions were obtained at $\theta_{Lab} = 170°$, and, besides, at 30 and 60° in case of the reaction ^{9}Be(α,d)^{11}B. Analyzing the results, obtained in region of large angles of the deuteron emission, one concludes that the stripping mechanism for a heavy particle may explain qualitatively the behavior of the differential cross sections at angles near 180° except in case of the reaction ^{11}B(α,d_0)^{13}C for which no satisfactory agreement was obtained. (auth)

27615 CREATION AND ABSORPTION OF PHOTOPIONS ON NUCLEONS OF THE NUCLEI ^{12}C, ^{28}Si, ^{40}Ca, ^{93}Nb, ^{181}Ta AT E_γ = 340 MeV. Tonapetyan, S. G.; Goncharov, N. V.; Khvorostyan, V. M. (Physical-Technical Inst., Kharkov). Yad. Fiz.; 22: No. 3, 440-445(Sep 1975). (In Russian).

Energy spectra are measured of pions and protons, emitted under the angle $\theta_{l.s.} = 90°$ at interaction of photons with E_γ^{max} = 300 and 400 MeV with nuclei ^{12}C, ^{28}Si, ^{40}Ca, ^{93}Nb, ^{181}Ta. The particles were registered by means of the freon bubble chamber in the energy intervals E_π = 30 to 120 MeV and E_p = 70 to 240 MeV. Using the photon difference method, dependences on the nuclear mass number are obtained for the differential cross sections $(d\sigma/d\Omega)_{90°}$ of the pion and proton emission. Comparison of the experimental data and the calculated quantities is presented for the pion photoproduction cross sections on nucleons of the investigated nuclei. In conclusion a deduction that the mechanism of absorption of photopions, produced on the nucleons in the atomic nucleus, is dominating in the yield of the photoprotons at $E_\gamma \sim 300$ MeV. (auth)

27616 ACCOUNT FOR INSTABILITY OF FINAL NUCLEUS STATES IN THE REACTION ^{6}Li(e,e',p)^{5}He. Mel'nik, Yu. P.; Inopin, E. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 12, 2032-2039(Dec 1975). (In Russian).

The interaction between the nucleons of ρ-shell is taken into consideration in the oscillator shell model to describe the Li^6 nucleus account for both resonance states $\rho_{\frac{3}{2}}$ and $\rho_{\frac{1}{2}}$ and nonresonance state $s_{\frac{1}{2}}$ of the unstable ^{5}He nucleus when calculating energy and angular distributions for the reaction ^{6}Li(e,e',p)^{5}He. A satisfactory agreement with experimental data is obtained. The calculations show that the presence of the nonresonance state $s_{\frac{1}{2}}$ in the region of excitation energy of ^{5}He of about 10 MeV results in noticeable filling of the minimum in the cross-section, the final nucleus momenta being small, in appearance of asymmetry in angular distribution. (auth)

27617 STUDY OF THE LEVELS OF LIGHT NUCLEI BY ANGULAR CORRELATION MEASUREMENT IN THE (d,pγ) REACTION. Huang, S. L.; Hsu, W. S.; Liu, Y. C. (National Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 13: No. 2, 252-256(Oct 1975).

The scattering chamber arrangement and the electronics system for the particle-gamma-ray angular correlation measurements are set up and described. The total set up system is then used to study the first excited state of ^{10}Be by the reaction ^{9}Be(d,pγ)^{10}Be at incident energy E_d = 1.5 MeV. The obtained spin and parity assignment for the level is 2^+. (auth)

27618 ENERGY DEPENDENCE OF (π^-,^{12}C) BACKWARD-SCATTERING CROSS SECTION. Guaraldo, C. (CNEN, Frascati, Italy); Scrimaglio, R.; Falomkin, I. V. Lett. Nuovo Cim.; 15: No. 11, 369-372(13 Mar 1976).

The results obtained measuring the backward elastic scattering differential cross section in the energy region 55 to 95 MeV are compared with the predictions of two recent developments of the Kisslinger optical potential. (JFP)

27619 ANALYSIS OF QUASIELASTIC (p,n) REACTION BY MEANS OF THE DISTORTED WAVE METHOD. Azimov, S. A.; Arifkhanov, U. R.; Gulyamov, M.; Kim, G.; Mannanov, E. A.; Markov, V. I. (Inst. of Nuclear Physics, Tashkent). Yad. Fiz.; 22: No. 4, 704-708(Oct 1975). (In Russian)

Measured differential cross sections of the (p,n) transitions between the isobaric analog states are compared with calculations of the optical model with introduction of a potential term proportional to $\mathbf{t} \cdot \mathbf{T}_0$, where t and T_0 are isospins of the projectile and target, respectively. The calculations are fulfilled by means of the distorted-wave method in the Born approximation using parameters of the optical potential that reconstruct data on the elastic scattering. Numerical computations are carried out, that show sensitivity of the angular distributions to variation of parameters of the optical potential. 2 figures, 1 table. (auth)

27620 EMISSION OF DEUTERONS IN PHOTODISINTEGRATION OF ^{7}Li. Denisov, V. P.; Chubukov, I. Ya. (Leningrad Inst. of Nuclear Physics). Yad. Fiz.; 22: No. 5, 897-901(Nov 1975). (In Russian)

Energy distributions of photodeuterons from ^{7}Li are measured at various values of the bremsstrahlung maximum energy. The difference spectra of deuterons show that in the ^{7}Li giant resonance region an intensive (γ,d_0) reaction proceeds with production of the ^{5}He nucleus in its ground state. A group of deuterons which may be due to the (γ,d_1) reaction with production of a final nucleus in the first excited state is found. The integral cross sections of those reactions (under an assumption that the (γ,d_1) reaction really proceeds) are obtained to be correspondingly 4.0 ± 0.5 and 3.2 ± 0.7 MeV · mb for $E_\gamma = 16.5 \div 30$ MeV. Besides, there was observed an emission of deuterons which fact should be due to the decay of the ^{7}Li states with 25-30 MeV energies into n + d + ^{4}He (5 ± 2 MeV · mb) as well as due to some complicated decays of ^{7}Li (~5 MeV · mb) induced by 37-50 MeV γ quanta. 4 figures, 1 table. (auth)

27621 QUASIELASTIC ELECTRON SCATTERING ON NUCLEI. Gorchakov, V. V.; Goy, A. A.; Reznik, B. L. (Far-Eastern State Univ., Vladivostok, USSR). Yad. Fiz.; 22: No. 5, 987-996(Nov 1975). (In Russian)

The missing-energy spectra of residual nuclei and the angular distributions of protons in (e,e'p) reactions on ^{12}C and ^{40}Ca are calculated. Consistent application of the model, in which the many-body effects are taken into account makes it possible to get a good agreement with the available experimental data. Some model conclusions enabling, in particular, to remove the contradiction in existing data on 1s-proton binding energy in ^{40}Ca are discussed. The $d^2\sigma$-cross section is derived taking widths of the hole states into account. Thus the influence of the many-body effects on the quasielastic electron spectra is evaluated. 8 figures. (auth)

27622 NUCLEAR REACTIONS WITH BERYLLIUM IONS. Venikov, N. I.; Glukhov, Yu. A.; Manko, V. I. (Inst. of Atomic Energy, Moscow). Yad. Fiz.; 22: No. 5, 924-933(Nov 1975). (In Russian)

Various reactions induced by 26 MeV beryllium ions are studied: (^{9}Be,p), (^{9}Be,d), (^{9}Be,t), (^{9}Be,α) and (^{9}Be, ^{6}He) on ^{6,7}Li, ^{9}Be, ^{10,11}B, ^{12,13}C, ^{16}O and ^{28}Si nuclei. It is shown that the interaction is mainly the ^{9}Be decay contributed considerably by a two-step process related to the reaction ^{9}Be → ^{8}Be(g.s.) + n. The excitation of discrete states is, for the most part, a result of production of a compound nucleus. At the same time the direct transfer mechanisms are as well present in the reactions. E.g., r five-nucleon cluster ^{5}He was transferred and quintet states of the kind 5p-4h were excited in the reaction ^{12}C(^{9}Be, α)^{17}O. The spectra measured by the lithium targets are close to the spectra from reactions induced by lithium ions on the ^{9}Be nucleus at large angles. 6 figures, 2 tables. (auth)

27623 HEAVY ION ALPHA-TRANSFER REACTIONS IN THE s-d SHELL. Pilt, A. A. (Oxford Univ.). Nukleonika; 20: No. 7-8, 801-804(1975).

Final states in ^{16}O corresponding to the alpha-transfer in the ^{12}C (^{20}Ne, ^{16}O) ^{16}O reaction were observed. Comparison was made of the energy spectra obtained with those predicted by SU(3) calculations. They are in good general agreement suggesting that at high energies reaction proceeds primarily by cluster transfer. (auth)

27624 QUASIELASTIC SCATTERING OF HIGH-ENERGY ELECTRONS AND SHORT-RANGE DYNAMICAL CORRELATIONS IN NUCLEI. Jibuti, R. I.; Kezerashvili, R. Ya. (Inst. of Physics, Tbilisi, USSR). Yad. Fiz.; 22: No. 5, 975-986(Nov 1975). (In Russian)

A diagram method is developed that enables one to consider contributions from short-range dynamical correlations (SRC) of any order to processes of quasielastic scattering of high-energy electrons on nuclei. Taking as examples the reactions ^{12}C(e,e'p)^{11}B

and $^{16}O(e,e'p)^{15}N$, when the electron-proton coincidence is detected, it is shown that introduction of SRC results in an essential change of the cross section even in the one-pair approximation. Maxima appear in regions of small and large scattering angles of the protons. Account for higher-order SRC sharpens these maxima and shifts the minima toward lower momentum transfers. As the single-particle functions for the independent-particle models, the harmonic oscillator functions, as well as the Woods–Saxon functions were used. 5 figures. (auth)

27625 NUCLEAR LEVELS AS ANALYSERS OF HIGH ENERGY INTERACTIONS. Scipione, D. S. San Diego, CA; Univ. of California (1975). 139p. University Microfilms Order No. 75-29,461.

Thesis (Ph. D.).

Nuclear excited states which emit photons can be profitably used to study high energy interactions, because the detection of the characteristic, monochromatic photons offers the possibility of triggering spark chambers for interactions occurring coherently with respect to the nucleus, and resulting in a final state with quantum numbers that satisfy the constraints imposed by the ground and excited states. Experimentally, it is found that such a technique is quite feasible for the first excited state of carbon, C(4.4 MeV), (J/sup pi/ equals 0^+, I equals 0) which differs from the ground state (J/sup pi/ equals 2^+, I equals 0) only by the natural cross section for incident pions is 2 mb and for incident protons is 3 mb. The cross section is independent of momentum from .68 to 4.0 BeV/c, indicating that C(4,4) favors diffractive interactions. The recoil-photon angular correlation for incident pions, showing a virtually total polarization in the m equals 0 state along the recoil direction, is also consistent with the diffractive selection feature. The differential cross section for pions remains usably large for momentum exchanges of t equals .1. Data are given for the differential cross section and photon-recoil correlation for the excitation of C(4,4) by alpha particles. Within limited statistics the angular correlation seems different than that for pions. The excitation of the 15.1 MeV level of carbon has been observed (J/sup pi/ equals 1^+, I equals 1) which requires the flipping of one unit of both mechanical and isotopic spin. For protons the total excitation cross section decreases from 200 microbarns at .7 BeV/c to less than 20 at 2 BeV/c. For pions of .7 BeV/c the cross section is 3.5 microbarns. These results are explained in terms of the symmetry of the carbon nucleus. (Diss. Abstr. Int., B)

27626 DECAYS OF T EQUALS $\frac{3}{2}$ LEVELS IN MASS 13 AND T EQUALS 2 LEVELS IN MASS 20. Marrs, R. E. Seattle; Univ. of Washington (1975). 185p. University Microfilms Order No. 75-28,394.

Thesis (Ph. D.).

Coincidence measurements have been made of both the electromagnetic and particle decays of the lowest T equals $\frac{3}{2}$ levels in ^{13}C and ^{13}N. Proton decays of ^{13}N(T equals $\frac{3}{2}$) to negative parity levels in ^{12}C at 9.64 and 10.84 MeV have been discovered using the $^{11}B(^3He,np)^{12}C$ reaction. The branching ratios for these d- or s-wave decays were found. Measurements of the alpha decays of the mirror T equals $\frac{3}{2}$ level in ^{13}C have shown that less than 14 percent of the width of the ^{13}C-(T equals $\frac{3}{2}$) level is accounted for by alpha decay to narrow states in ^9Be. The $^{11}B(^3He,$ p gamma$)^{13}C$ and $^{11}B(^3He,$ n gamma$)^{13}N$ reactions have been used to make a careful comparison of the gamma-ray transition strengths from the lowest T equals $\frac{3}{2}$ levels in ^{13}C and ^{13}N. The relative transition strength for the M1 decays to the $\frac{1}{2}^-$ ground state and $\frac{3}{2}^-$ second excited state was found to be the same in ^{13}C and ^{13}N with a precision of +- 6.5 percent. The absolute gamma-ray transition strengths in ^{13}C and ^{13}N have also been compared using the ^{13}C (p, gamma$_0$)^{13}N reaction to obtain a value of GAMMA/sub gamma$_0$/ equals 24.5 +- 1.5 eV for the T equals $\frac{3}{2}$ level in ^{13}N. The reduced E1 transition-strength to the $\frac{1}{2}^+$ first excited state was found to be (6.4 +- 1.1) x 10^{-3} W.u. in ^{13}C and (3.69 + 0.39) x 10^{-3} W.u. in ^{13}N. The ^{19}F (p, gamma)^{20}Ne reaction has been used to obtain upper limits of (5 - 10) x 10^{-5} W.u. for several DELTA T equals 2 E1 transitions from the two lowest T equals 2 levels in ^{20}Ne. The ^{19}F (^{3}He, d gamma)^{20}Ne reaction has been used in combination with previous measurements to infer a value of GAMMA/sub gamma/ approximately equal to 1.2 eV for the radioactive width of 2^+, T equals 2 level in ^{20}Ne. The ^{19}F (^{3}He, d gamma)^{20}Ne reaction has also been used to provide the first measurement of the gamma-decay schemes for three levels in ^{20}Ne at E/sub x/ equals 9.87 +- 0.04, 10.89 +- 0.04 and 11.59 +- 0.04 MeV. (Diss. Abstr. Int., B)

27627 ELASTIC SCATTERING OF LITHIUM BY ^9Be, ^{10}B, ^{12}C, ^{13}C, ^{16}O, AND ^{28}Si FROM 4 TO 63 MeV. Poling, J. E. Iowa City, IA; Univ. of Iowa (1975). 83p. University Microfilms Order No. 76-2164.

Thesis (Ph. D.).

Elastic scattering angular distributions have been measured at energies between 4.5 and 13.0 MeV for ^6Li and ^7Li beams and targets of ^{10}B, ^{12}C, ^{13}C, ^{16}O, and ^{28}Si. Yield curves have been measured for energies from 3.0 to 13.0 MeV for ^6Li beams and targets of ^9Be, ^{12}C, ^{13}C, ^{16}O, and ^{28}Si, and for ^7Li on ^{12}C. The angular distributions, supplemented by angular distributions which have been published by other experimenters, have been fitted with optical-model potentials. For $^6Li + ^{12}C$, angular distributions were available at sixteen different energies from 4.5 to 63.0 MeV. The usual ambiguities were observed in the optical-model potentials. However, potentials were obtained which gave fits to the data with acceptable chi-square values across the entire energy range available for each elastic scattering reaction. In certain cases the back angles were not well fitted by any parameter sets which were useful for all energies. The quality of the fits did not seem to be limited by experimental errors, which were generally better than 10 percent for our data; compound nucleus effects are presumed to be the cause of the rapid energy variations in the angular distributions. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 27356, 27593, 27594, 27604, 27612, 27613, 27615, 27619, 27622, 27627, and 27778.

27628 SEARCH FOR A $2p_{\frac{1}{2}}$ ANALOG STATE IN ^{35}Cl. Kopanets, E. G.; Migalenya, V. Ya.; L'vov, A. N.; Koval, A. A.; Kostin, V. Ya.; Gaidamaka, A. P.; Tsytko, S. P. Bull. Acad. Sci. USSR, Phys. Ser.; 34: No. 10, 1873-1876(Oct 1970).

From 20th annual conference on nuclear spectroscopy and nuclear structure; Leningrad, USSR (28 Jan 1970). Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: No. 10, 2101-2104 (Oct 1970).

The presence in ^{35}Cl of states with isospin T = $\frac{3}{2}$ and excitation energies in the interval 7.0-10.0 MeV has been known for some time. These states are isobaric analogs of ^{35}S levels and fit well into the simple shell model scheme. This scheme contains no level that might be associated with the $2p_{\frac{1}{2}}$ shell. Such a state is apparently to be sought between the $f_{\frac{7}{2}}$ and $g_{\frac{9}{2}}$ shells, i.e., among the ^{35}Cl levels with excitation energies in the 8.4-9.2 MeV interval. Assuming that the resonance strength in the radiative proton capture reaction for an isobaric analog state of single-particle type is many times larger than that for the basic resonances, it was decided that the 2317, 2323 and 2336 keV resonances in the $^{34}S(p,\gamma)^{35}Cl$ reaction established in previous work would be studied. (auth)

27629 $^{29,30}Si(^{16}O,^{15}N)$ PROTON STRIPPING REACTION AT 60 MeV. Dehnhard, D.; Artz, J.L.; Weber, D.J.; Shkolnik, V. (Williams Laboratory of Nuclear Physics, University of Minnesota, Minneapolis, Minnesota 55455); DeVries, R.M. Phys. Rev. C 13: No. 1, 164-170 (Jan 1976).

Differential cross sections of the ($^{16}O,^{15}N$) (g.s.) reaction on ^{29}Si and ^{30}Si were measured at E (^{16}O) =60 MeV at far forward angles. The strongly oscillatory ΔL=1, (2) angular distributions for the $2s_{1/2}$ and $1d_{3/2}$ transitions to ^{30}P and ^{31}P were found to be out of phase. The pure ΔL=1, $2s_{1/2}$ transitions were fitted well by finite range distorted wave Born approximation calculations using the code LOLA. The phase of the structure of the $1d_{3/2}$ transfer angular distributions could not be fitted with the distorted wave Born approximation. Spectroscopic factors were in good agreement with (^{3}He,d) results for $2s_{1/2}$ and $1d_{5/2}$ transitions and a factor of 2 too large for $1d_{3/2}$ transfer. This factor of 2 for the $1d_{3/2}$ transitions is not understood. The mixed j transition to the 2^+ state in ^{30}P (1.454 MeV) was found to be consistent with almost exclusive j=3/2 transfer as predicted by shell model calculations. (auth)

27630 SPECTROSCOPIC FACTORS FOR (d,p) STRIPPING REACTIONS WITH DIFFERENT REPULSIVE CORE NUCLEON-NUCLEON POTENTIALS. Osman, A. (International Center for Theoretical Physics, Trieste, Italy); Zaky, M. Phys. Rev. C 13: No. 1, 1-8 (Jan 1976).

Deuteron stripping reactions are considered. The short-range correlations for the nucleons in the nuclei are taken into account. The neutron-proton nuclear potential in the deuteron is taken as a long-range attractive potential surrounded by a short-range repulsive potential. We take different forms for the two parts of the neutron-proton nuclear potential. The differential cross sections for the two nuclear reactions $^{28}Si(d,p)^{29}Si$ and $^{40}Ca(d,p)^{41}Ca$ have been calculated for each of the nuclear potential forms. Fitting our theoretical calculations, with the experimental data, using the distorted-wave Born-approximation calculations, a good agreement is obtained. The more reliable spectroscopic factors for these reactions have been extracted. (auth)

27631 SPECTROSCOPY OF THE (α, 2α) REACTION AT E_α = 90 MeV. Sherman, J.D.; Hendrie, D.L.; Zisman, M.S. (University

of California, Lawrence Berkeley Laboratory, Berkeley, California 94720). Phys. Rev. C 13: No. 1, 20-34 (Jan 1976).

Nine target nuclei ^{12}C, ^{16}O, $^{24,26}Mg$, $^{28,30}Si$, $^{40,44}Ca$, and ^{66}Zn have been studied by the $(\alpha,2\alpha)$ reaction at an incident beam energy of 90 MeV. Energy resolution of 250–300 keV full width at half-maximum permitted identification of many excited states, although transitions to the ground state consistently dominated the spectra. The ground state angular correlations for equal outgoing energies and angles were similar in shape over this mass region although the magnitude decreased by a factor of 10 from ^{12}C to ^{66}Zn. A phenomenological distorted wave impulse approximation calculation successfully describes most of the angular and energy correlations. A conspicuous failure of the calculation occurs in the energy correlation predictions for recoil momenta greater than 0.6 fm^{-1}. Spectroscopic results are compared with those from α pickup reactions. It is seen that both reactions give nearly the same α clustering mass dependence. Plane wave impulse approximation analysis suggests that the principal parent of ^{16}O in an α particle model is the ^{12}C ground state rather than the first excited state as found in the α pickup reactions. (auth)

27632 SINGLE PROTON TRANSFER TO $^{29,30}P$ STATES. Dykoski, W.W.; Dehnhard, D. (John H. Williams Laboratory of Nuclear Physics, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. C 13: No. 1, 80-97 (Jan 1976).

Differential cross sections were measured for the $(^3He,d)$ reaction on ^{28}Si and ^{29}Si at $E_{^3He}=25$ MeV by use of an Enge split-pole spectrometer. Up to 19 point angular distributions for transitions to 12 states in ^{29}P below 6.4 MeV excitation energy and to 66 states in ^{30}P below 8.7 MeV were analyzed in the distorted-wave Born approximation. The optical model parameters required for the distorted-wave Born approximation analysis were obtained from elastic ^3He scattering data which were taken on ^{28}Si, ^{29}Si, and ^{30}Si. A number of ^{30}P levels were found to have large components of simple two-particle structure, with one particle in the $2s_{1/2}$ shell and the other either in the $2s_{1/2}$, $1d_{3/2}$, $1f_{7/2}$, or $2p_{3/2}$ shells. Specifically, the states at 6092 and 7048 keV were assigned $J^\pi=3^-$, $T=1$ and $J^\pi=4^-$, $T=1$, respectively, because they were found to carry a significant fraction of the $(2s_{1/2})(1f_{7/2})$ strength. However, the $T=0$ components of the $(2s_{1/2})^2_{1+}$, $(2s_{1/2})(1d_{3/2})_{1+}$, and $(1d_{5/2})^{-1}(2s_{1/2})^3_{3+}$ configurations were found to be distributed among a large number of states. Spin assignments were made based on shapes of the angular distributions and analog relations to ^{30}Si states. An estimate of the extent to which the $1d_{5/2}$ proton shell is filled in ^{28}Si and ^{29}Si was extracted. (auth)

27633 INTERMEDIATE-ENERGY (40 MeV $\lesssim E_\gamma \lesssim$ 400 MeV) PHOTONUCLEAR INTERACTIONS. Gabriel, T.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee, 37830). Phys. Rev. C 13; No. 1, 240-244 (Jan 1976).

Comparisons between theoretical and recent experimental photoproton spectra are presented for 400-MeV bremsstrahlung on carbon, aluminum, copper, and gold. Experiments are suggested which would facilitate further theoretical considerations. (auth)

27634 DECAY OF ^{36}K. Fritts, M.J. (Nuclear Physics Laboratory, Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302). Phys. Rev. C 13: No. 1, 331-338 (Jan 1976).

^{36}K was produced via the $^{36}Ar(p,n)^{36}K$ reaction. Measurement of 27 β^+ delayed γ rays associated with the decay of ^{36}K implied 10 new β^+ branches to energy levels in ^{36}Ar. Branching ratios and logft values are calculated for the β^+ branches. Restrictions on spin and parity assignments for the ^{36}Ar levels are given, as well as branching ratios for γ transitions from these levels. The half-life of ^{36}K is determined to be 344 ± 3 msec. (auth)

27635 DSA LIFETIMES IN ^{21}Na AND ^{23}Na DERIVED FROM EXPERIMENTAL STOPPING PARAMETERS. Anttila, A.; Bister, M.; Keinonen, J. (Helsinki Univ. (Finland). Dept. of Physics). Z. Phys., A; 274: No. 3, 227-232(1975).

The lifetimes for the second excited state in ^{21}Na and for the second to ninth excited states in ^{23}Na have been determined with the DSA method using Ta_2O_5 and Ta as stopping materials. In the DSA analysis the experimental stopping parameters determined in the present and earlier works were utilized. The reanalysis of some earlier studies has brought very good consistency to the scattered results. Comparison of the observed transition strengths with theory has also been made. (DE)

27636 FOURIER TRANSFORM NUCLEAR MAGNETIC RESONANCE STUDIES OF ^{25}Mg AND ^{43}Ca. Lutz, O.; Schwenk, A.; Uhl, A. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Z. Naturforsch., A; 30: No 9, 1112-1127(Sep 1975).

6 figs.; 3 tabs.; 25 refs.

The ratios of the Larmor frequencies of ^{25}Mg and ^{37}Cl and of ^{43}Ca and ^{37}Cl have been measured in aqueous solutions, and nuclear magnetic moments are given for these nuclei in the hydrated ions. ^{25}Mg and ^{43}Ca chemical shifts have been investigated at natural abundance of these isotopes in solutions of the chlorides, bromides, nitrates, perchlorates in H_2O and D_2O. The signal intensities are large enough to study within reasonable time these nuclei at natural abundance down to low concentrated solutions, e.g. 8 millimolal for ^{25}Mg. For ^{25}Mg very small chemical shifts have been observed whereas for ^{43}Ca remarkable shifts to higher frequencies are found for halide solutions and to lower frequencies for the oxyanion solutions. Linewidths of only some Hz have been observed for both isotopes. (DE)

27637 SPECTRA OF p, d, AND t DURING BOMBARDMENT OF ^{27}Al AND ^{59}Co NUCLEI WITH 50.5-MeV α PARTICLES. Duisebaev, A. D.; Laptev, S. V.; Spasskii, A. V.; Teplov, I. G.; Shalabaev, D. A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 19-22(1974). (In Russian)

The energy spectra of p, d, and t formed in reactions of ^{27}Al and ^{59}Co with 50.5-MeV α particles were measured. The measurements were made at four angles of flight of the particles in the interval from 21 to 90°. It was found that the spectra of identical secondary particles from both the nuclei studied were similar in form, whereas the form of the spectra and the yield of the different particles differed sharply in the two nuclei. The characteristics of the measured spectra were in qualitative agreement with the assumption that cluster stripping is the basic direct process in the reactions studied. (tr-auth)

27638 EXCITED STATES OF ^{32}P. Karadzhev, K. V.; Mazurov, I. B.; Manko, V. I.; Nersesyan, A. N. (Inst. of Atomic Energy, Moscow). Yad. Fiz.; 22: No. 5, 886-892(Nov 1975). (In Russian)

Excited states of the nucleus ^{29}P with energies 4.97 MeV and 5.30 MeV have been investigated. To this purpose excitation functions were studied for the elastic scattering of protons on nuclei ^{28}Si and for the reactions $^{28}Si(p,p'\gamma)^{28}Si$ and $^{28}Si(p,\gamma)^{29}P$, as well the γ spectra at the energies corresponding to the mentioned resonance states. Analyzing the obtained data, partial widths are found for elastic and inelastic channels, as well as absolute widths of the observed γ transitions. Comparison with one-particle estimates is carried out.

27639 FINE STRUCTURE OF THE GIANT RESONANCE IN ^{20}Ne AND ^{40}Ar. Chkalov, I. I.; Shevchenko, N. G.; Buki, A. Yu.; Khomich, A. A.; Litvinenko, A. S.; Polishchuk, V. N. (Physical-Technical Inst., Kharkov). Yad. Fiz.; 22: No. 5, 893-896(Nov 1975). (In Russian)

The experimental data are presented on the fine structure of the giant resonance in the nuclei ^{20}Ne and ^{40}Ar by the method of inelastic scattering of electrons. A correlation is observed between energy positions of the fine structure maxima of the giant resonance in the nuclei ^{20}Ne and ^{40}Ar and positions of the discrete levels in the nuclei ^{19}F and ^{39}Ar, respectively. 3 figures. (auth)

27640 SCATTERING OF 1 GeV PROTONS ON ^{28}Si, ^{32}S, ^{34}S. Alkhazov, G. D.; Belostotskii, S. L.; Vorobev, A. A.; Grachyov, V. T.; Domchenkov, O. A.; Dotsenko, Yu. V.; Kuropatkin, N. P.; Starodubskii, V. E.; Shuvaev, M. A. (Leningrad Inst. of Nuclear Physics). Yad. Fiz.; 22: No. 5, 902-910(Nov 1975). (In Russian)

Differential cross sections of elastic and inelastic scattering of protons with energy 1 GeV on nuclei ^{28}Si, ^{32}S, and ^{34}S are measured. Analysis of the experimental data is fulfilled in framework of the diffractional multiple scattering theory with account of excitation of collective degrees of freedom. It is shown that in such an approach one may simultaneously describe the available experimental data on elastic and inelastic electron and proton scattering on nuclei. 6 figures. (auth)

27641 STRIPPING REACTIONS (d,p) ON ^{24}Mg AND ^{25}Mg AT DEUTERON ENERGY OF 13.6 MeV. Tokarevskii, V. V.; Shcherbin, V. N. (Inst. of Nuclear Energy, Kharkov). Yad. Fiz.; 22: No. 5, 917-923(Nov 1975). (In Russian)

Differential cross sections of (d,p) reactions are measured in the angular range of 6° to 171°. A considerable difference in the integral cross sections is observed for some transitions with equal l. The experimental results are analyzed in the DWBA. The possibility of using DWBA to describe (d,p) reactions on deformed nuclei is discussed. The values of the spectroscopic factors are obtained for the states under investigation. 2 tables, 2 figures. (auth)

27642 THERMAL NEUTRON CROSS SECTIONS AND (n,gamma) RESONANCE INTEGRALS. I. Gleason, G. (Oak Ridge Associated Universities, TN). Radiochem. Radioanal. Lett.; 23: No. 5-6, 317-323(19 Dec 1975).

By activation in a graphite-moderated ^{252}Cf facility, thermal cross sections and resonance integrals have been measured for 18 nuclides. In general, these determinations have shown only minor differences from published values. A noted exception is the thermal cross section for the $^{81}Br(n,gamma)^{82}Br$ reaction which was found to be 2.1 +- 0.1 barns (combining the metastable

state) which is significantly lower than the values of about 3 barns found in the literature. 2 tables (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 27385, 27593, 27615, 27621, 27630, 27631, 27642, 27664, and 27680.

27643 (CRN-PN-75-36) LIFETIME AND g-FACTOR MEASUREMENTS IN ^{44}Sc. Chevallier, A.; Chevallier, J.; Gross, J. L.; Haas, B.; Schulz, N.; Styczen, J.; Toulemonde, M. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 10p. INIS.

The lifetimes of the 235 keV, 2$^-$ state and 350 keV, 4$^+$ state in ^{44}Sc have been measured via the ^{44}Ca(p,n)^{44}Sc reaction with a pulsed proton beam. The time integral perturbed angular distribution technique with an external field was used to measure the precession angles of the 2$^-$ and 4$^+$ states populated by the ^{30}Si(^{16}O, pnγ)^{44}Sc reaction. The following values for the mean-lives and g-factors were obtained: $\tau(2^-)$ = 8.83(33)ns, g(2$^-$) = 0.30(13) and $\tau(4^+)$ = 4.52(27)ns, g(4$^+$) = 0.90(12). The results for the 2$^-$ state support a rotational description of the negative parity states in ^{44}Sc. The magnetic moment of the 4$^+$ state is compared to shell model predictions. (FR)

27644 (ORNL/TM-5161) CALCULATED NUCLEON SPECTRA AT SEVERAL ANGLES FROM 192-, 500-, 700-, AND 900-MeV CARBON-12 ON IRON-56. Bertini, H. W.; Santoro, R. T.; Hermann, O. W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 17p. Dep. NTIS $5.00.

Neutron spectra were calculated as a function of angle between 0 and 110^0 for ^{12}C on ^{56}Fe at 192, 500, 700, and 900 MeV. Proton spectra were calculated for the same angular range but for only 192-MeV ^{12}C on ^{56}Fe. The most significant property of these spectra is that there is an appreciable number of neutrons emitted with energies greater than the incident energy per nucleon at all angles investigated. 9 figures. (auth)

27645 LIMITS ON THE PARTICLE DECAYS OF THE LOWEST T=2 STATE IN ^{44}Ti. Freedman, S.J.; Nero, A.V.; Oothoudt, M.A.; Zutavern, F.J. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 36: No. 5, 279-281 (2 Feb 1976).

Experimental limits on the branching ratio for charged-particle decay of the lowest T=2 state in ^{44}Ti are obtained. The implications for recent γ-decay studies of this state are discussed. (auth)

27646 HEAVY-ION L=1 TRANSFER: A SENSITIVE TEST OF REACTION THEORY. Bond, P.D.; Chasman, C.; Garrett, J.D.; Gelbke, C.K.; Hansen, O.; LeVine, M.J.; Schwarzschild, A.Z.; Thorn, C.E. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 36: No. 6, 300-303 (9 Feb 1976).

Angular distributions presented for reactions ^{40,42,44}Ca(^{13}C, ^{14}N)^{39,41,43}K (transferred L=1 at 68-MeV bombarding energy are observed to oscillate out of phase with exact, finite-range, distorted-wave-Born-approximation (DWBA) calculations. It is shown that differential cross sections for L=1 transfer reactions are particularly sensitive tests of the DWBA. Simple arguments follow which indicate that the difficulty in fitting present data lies with our understanding of the reaction mechanism. (auth)

27647 LEVEL STRUCTURE MEASUREMENTS WITH THE (p,α), (^{3}He,d), AND (^{3}He,dγ) REACTIONS: ENERGY LEVELS IN ^{51}Mn AND ^{53}Mn. *Tarara, R.W.; Goss, J.D.; Jolivette, P.L.; Neal, G.F.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 13: No. 1, 109-117 (Jan 1976).

The level structures of ^{51}Mn and ^{53}Mn have been studied using our 100-cm broad range magnetic spectrograph and the ^{54}Fe(p,α)^{51}Mn and ^{56}Fe(p,α)^{53}Mn reactions. Precise level energies in ^{51}Mn have been measured up to the region of 4 MeV in excitation. Thirty-four states have been identified in this region of excitation, 10 of which have not previously been reported. The uncertainty in energy of the third excited state at 1488.9 keV has been reduced from 10 keV to 0.8 keV. We confirm the new levels at 2893 and 3049 proposed in a recent ^{50}Cr(p,γ)^{51}Mn experiment but do not observe levels at 2488, 2660, 2717, and 2808 reported in an earlier ^{50}Cr(p,γ) experiment. Using the ^{56}Fe(p,α)^{53}Mn reaction we have found 28 previously unreported levels in the region up to 5.1 MeV in excitation. We confirm the existence of four of the five high spin states recently reported in ^{50}Cr(α,p γ)^{53}Mn work at 2563.7, 2693.5, 2697.3, 3425.6, and 3440.5 keV. We were unable to resolve the 3.8-keV doublet at 2694 keV. We do not observe levels at 1940, 2448.1, 2761.0, 2967.3, and 2978.1 keV which have been proposed or observed in previous ^{52}Cr(p,γ) studies. In addition we did not observe the levels reported at 2370 and 3061 keV in previous ^{52}Cr(^{3}He,d)^{53}Mn experiments. Our ^{52}Cr(^{3}He,d)^{53}Mn and ^{52}Cr(^{3}He,dγ) ^{53}Mn measurements do not show these levels. (auth)

27648 LOW-LYING LEVELS OF ^{57}Mn FROM THE ^{54}Cr(α,p) REACTION. Mateja, J.F.; Neal, G.F.; Goss, J.D.; Chagnon, P.R.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 13: No. 1, 118-123 (Jan 1976).

Proton energy spectra from the ^{54}Cr(α,p)^{57}Mn reaction at 15, 21, and 24 MeV and at several angles have been measured with the 100-cm broad-range spectrograph. Both NaI(Tl) and Ge(Li) detectors have been used to study γ rays, in coincidence with protons in a particle detector, from the same reaction. From the spectrograph measurements, the ground-state Q value is found to be −4308±8 keV. Excited levels have been found at 84.1±1.0, 851.1±1.0, 1059.2±2.0, 1073.8±2.0, 1227.1±1.0, 1376.5±1.3, 2188.2±1.1, and 2234.3±1.7 keV. Ten γ-ray transitions have been observed. From particle-γ coincidence and angular-correlation measurements the spins of some levels can be limited as follows: 84 keV, 3/2−7/2; 851 keV, 3/2 or 5/2; 1059 keV, 1/2−5/2. Probable spin assignments for these three levels suggested on the basis of cross-section and relative transition-strength considerations are (7/2), (3/2), and (1/2), respectively. Other tentative spin assignments, and the comparison of ^{57}Mn with other odd Mn isotopes, are discussed. (auth)

27649 TWO-NEUTRON STRIPPING REACTION (^{18}O, ^{16}O) ON ^{48}Ca. Petersen, J.F.; Lewis, D.A.; Dehnhard, D.; Morsch, H.P.; Bayman, B.F. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. Lett. 36: No. 6, 307-309 (9 Feb 1976).

Differential cross sections for ^{48}Ca(^{18}O, ^{16}O)^{50}Ca have been measured at 50 MeV. The ground-state transition has been analyzed with a two-nucleon transfer, distorted-wave Born-approximation code including finite-range and recoil effects. The calculations underpredict the experimental cross sections by a factor of 5, which is similar to the factor of 4 for ^{48}Ca(t,p). However a large discrepancy is found between the corresponding factors for two-neutron pickup from ^{48}Ca. (auth)

27650 8.875 MeV ISOBAR-ANALOG STATE IN ^{41}K. Kopanets, E. G.; Migalenya, V. Ya.; L'vov, A. N.; Koval, A. A.; Kostin, V. Ya.; Gaidanaka, A. P.; Tsytko, S. P. (Physical-Technical Inst., Kharkov). Bull. Acad. Sci. USSR, Phys. Ser.; 34: No. 8, 1558-1562(Aug 1970).

From 20th annual conference on nuclear spectroscopy and nuclear structure; Leningrad, USSR (25 Jan 1969). Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: No. 8, 1752-1756(Aug 1970).

The properties of the resonance in ^{40}Ar(p,γ)^{41}K at E_p = 1101 keV are studied. The 8.875 MeV state in ^{41}K is excited in this reaction and can be considered as an isobar-analog of the 0.52 MeV level of ^{41}Ar. (auth)

27651 MULTI-BAND SPECTRA OF ODD AND EVEN NUCLEI OF THE s−d SHELL. Parikh, J. K. Pramana; 6: No. 1, 42-58 (Jan 1976).

The energy levels of ^{21,23}Na, ^{22,23}Ne, ^{24,28}Mg, and ^{25,29}Al are obtained by mixing various bands using the projected deformed Hartree−Fock (DHF) method. Solutions having minimum energies are found to be prolate for all the nuclei considered here. Higher bands are obtained either by considering particle-hole excitations or oblate solutions. These various bands are mixed using the projection method and care has been taken to orthogonalize the bands. The interactions used in this study are those given by Kuo, Preedom−Wildenthal (PW) and WHMK interactions. The last one seems to give good results for most of the nuclei considered here. Not only are the lowest bands well-reproduced but the second lowest bands agree reasonably well in most nuclei. The third lowest ones obtained in some nuclei are not yet observed as complete bands. However, K obtained for the third band seems to be correct. A comparison with shell model calculations−which are numerically exhausting—shows similar results for the lowest band. However, the agreement of the second band varies from nucleus to nucleus. A comparison between matrix elements of the interactions is made to analyze the results. 3 tables, 8 figures. (auth)

27652 SPALLATION OF ^{55}Mn NUCLEUS BY PHOTONS WITH MAXIMUM ENERGY FROM 2 TO 5 GeV. Vartapetyan, G. A.; Demekhina, N. A.; Khudaverdyan, A. G.; Grigoryan, E. O.; Danagulyan, A. S. (Erevan Physical Inst.). Yad. Fiz.; 22: No. 3, 433-439(Sep 1975). (In Russian).

The results of photospallation of the ^{55}Mn nucleus in the 2 to 5 GeV energy region are presented. The yields of twenty residual nuclei in the (γ, xp, yn) reactions were measured by the induced activity of germanium−lithium detector. The cross sections of the reactions were obtained in the rectangular approximation.

The semiempirical Rudstam formula was used to analyze the results. (auth)

27653 INVESTIGATION OF THE STRUCTURE OF ^{45}Sc NUCLEUS. Dang, H. U.; Fenyes, T.; Gulyas, J.; Kiss, A.; Koltay, E.; Mate, Z. (Atomki, Debrecen, Hungary). ATOMKI (At. Kut. Intez.) Kozl.; 17: No. 3, 217-238(1975). (In Hungarian).

The scattered proton and γ radiations of the ^{45}Sc(p,p'γ)^{45}Sc reaction were studied with surface-barrier Si and Ge(Li) detectors at 2, 2.5, 3, 3.5, and 4 MeV bombarding-proton energies. From the 48 gamma rays associated with the decay of ^{45}Sc excited levels, 11 are new. The intensity of gamma rays was measured as a function of the bombarding proton energy. In the proton spectrum 18 inelastically scattered proton groups were observed, which are connected with ^{45}Sc excited states. The γ radiation of the ^{45}Ti → ^{45}Sc decay was also investigated. On the basis of the experimental results a new level scheme of the ^{45}Sc nucleus is proposed. Gamma-ray branching ratios were obtained for the excited levels. From the experimental results and different theoretical calculations, conclusions are drawn on the structure of the ^{45}Sc nucleus. (7 figures, 3 tables) (auth)

27654 MEASUREMENT OF THE SPECTRA OF INELASTIC INTERACTIONS OF NEUTRONS WITH AN INITIAL ENERGY OF 14.6 MeV. Kozyr, Yu. E.; Prokopets, G. A.; Strikhak, V. I. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 12, 2061-2063(Dec 1975). (In Russian).

The neutron emission spectra of Fe irradiated with 14.6-MeV neutrons was measured. The measurements were carried out in cylindrical geometry and the time correlation was determined from the accompanying α particles. The path length of the spectrometer was 3 m and its resolution was 3 nsec/m. The measured values of $d^2\sigma/d\Omega dE$ for scattering angle of 70° were compared with theoretical calculations and with the data of other authors. (tr-auth)

27655 STRUCTURE OF DOORWAY STATES IN THE ^{40}Ca + N REACTION. Castel, B.; Halderson, D. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Physics); Micklinghoff, M. (Hamburg Univ. (F. R. Germany). 1. Inst. fuer Theoretische Physik); Divadeenam, M. (Brookhaven National Lab., Upton, N. Y. (USA)). Z. Phys., A; 274: No. 3, 275-278(1975).

A model including 2p–1h and collective states in ^{41}Ca is used to investigate the intermediate structure resonances seen in the n + ^{40}Ca reaction. With potential well parameters determined by a calculation of the bound states it is found that most of the s-wave strength can be accounted for by the inclusion of one main doorway state component. (DE)

27656 ANGULAR DISTRIBUTION OF 14.4-keV γ QUANTA RESONANTLY SCATTERED ON ^{57}Fe NUCLEI. Dosmaganbetov, S. A.; Bashanov, S. A.; Zhetbaev, A. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 64-66(1974). (In Russian)

The angular distribution of resonantly scattered 14.4-keV γ quanta was measured by the angular correlation method and Moessbauer scattering in some Fe compounds. The angular distribution functions were determined in $K_4[Fe(CN)_6]3H_2O$, stainless steel 310, $K_4[Fe(CN)_6]$, $Fe_2(SO_4)_3nH_2O$, and $NaF_{0.39}Al_{0.61}O_2$. The magnitudes of the quadrupole splitting were also determined in the last three compounds. (tr-auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 27356, 27613, 27619, 27631, 27633, 27637, 27642, 27676, 27677, and 27778.

27657 (CEA-N-1817(Suppl.), pp 7-8) MEASUREMENT OF THE ENERGY SPECTRA AND EXCITED STATE POPULATION IN DELAYED NEUTRON EMISSION. Kratz, R.; Crawford, O.; Hall, K.; Ristori, C.; Crancon, J. 1975. (In French)

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin No. 7, January-June 1975. ILL experiments. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

The γ rays in coincidence with the delayed neutron emission from ^{95}Rb, ^{90}Br, and ^{85}As were measured using the on-line "Lohengrin" spectrometer and a detection unit including a NaI scintillator, and a liquid NE 213 scintillator. The γ coincidence emissions at 837 keV from deexcitation of the 2^+ level in ^{94}Sr was shown for the first time, with that at 424 keV from the first excited level in ^{89}Kr. (FR)

27658 (FRNC-TH-573) STUDY OF THE MONOPOLE INTERACTION BETWEEN THE NUCLEUS AND ITS ELECTRONIC ENVIRONMENT USING THE METHOD OF THE VARIATIONS IN DECAY RATE OF A RADIOACTIVE ISOTOPE. Auric, P. (Grenoble-1 Univ., 38 (France)). 1975. 124p. (In French). INIS.

The electron structure of certain elements was studied by nuclear and chemical techniques. Two main problems were dealt with: one concerning the chemical nature and properties of an impurity M present in very small concentrations in a molecular compound M.R., more precisely the recoil atoms obtained after (n,γ) reaction on copper phthalocyanine (CuPc); the other relating to the electron density at the nucleus present in stoichiometric quantities in various compounds, in this case zirconium in $PbZrO_3$ and ZrO_2 under variable physico-chemical conditions. In the case of CuPc the reactions of the recoil atom with its surroundings were analyzed by chemical kinetic studies. The recoil atom is considered as an impurity in the semiconductor in the same way as oxygen. An electron transfer process gives it enough energy for an exchange to take place with a CuPc molecule. The method of half-life variations showed that the copper making up the atoms has nuclear electron density lower than that of the copper belonging to a CuPc molecule. Calculations of the Hartree-Fock and Hartree-Fock-Slater type reflect the general change in the electron density between one configuration and another, and a $3d^{10}4s^0$ type configuration was hence adopted for the recoil atom. In the case of ^{95}Zr the influence of physico-chemical factors such as temperature, crystal phase and strong electric fields on the nuclear electron density was measured with good precision. (FR)

27659 (IAEA-169(Vol. 3), pp 3 v.; v. 3 p. 163-211) THERMAL AVERAGE, RESONANCE INTEGRAL AND FISSION-SPECTRUM AVERAGE NEUTRON CAPTURE CROSS SECTIONS OF NUCLIDES WITH Z = 30 TO 68. Pope, A. L.; Story, J. S. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

For the fission-product range, Z = 30 to 68, this report gives a comparative table of integral characteristics computed from capture cross sections in the many evaluated data files presently available in the format of the UK Nuclear Data Library. Similar data relating to the ENDF/B3 data library are included also. The integral characteristics listed are thermal average cross sections, resonance integrals, including the 1/V component, and fission spectrum averages. Selected means of the experimental data are listed also when available. (auth)

27660 (IAEA-169(Vol. 3), pp 3 v.; v. 3 p. 367-375) DELAYED NEUTRON SPECTROMETRY. Shalev, S.; Rudstam, G. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

A number of delayed neutron precursors have been isolated by mass-separation. The delayed neutron energy spectra were measured using a high resolution ^{3}He neutron spectrometer, and preliminary results are given for ^{87}Br, ^{88}Br, ^{135}Te, ^{137}I, ^{138}I, and ^{139}I. (auth)

27661 B(M1) VALUES FOR THE DECAY OF ANALOG STATES IN ^{43}Sc AND ^{47}Sc. Kemp, C. (Niels Bohr Inst., Copenhagen). Bull. Acad. Sci. USSR, Phys. Ser.; 34: No. 8, 1458-1460(Aug 1970).

From 20th annual conference on nuclear spectroscopy and nuclear structure; Leningrad, USSR (25 Jan 1969). Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: No. 8, 1641-1643(Aug 1970).

Because of the similarity between the Gamow-Teller interaction and the M1 interaction one can determine the "strength" of Gamow-Teller transitions by measuring the probability for an M1 transition in the de-excitation of the isobaric analog state $T_-|i_0\rangle$. A study of the γ rays arising in the de-excitation of the analog state in ^{43}Sc corresponding to the ground state of ^{43}Ca and the analog state in ^{47}Sc corresponding to the first excited level in ^{47}Ca, both of which have $I^\pi = 3/2^-$, has been made. (auth)

27662 NEUTRON PICKUP ON ^{84}Kr. Medsker, L.R.; Fortune, H.T.; Bishop, J.N. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 13: No. 1, 105-108 (Jan 1976).

The ^{84}Kr(^{3}He, α)^{83}Kr reaction has been studied at a bombarding energy of 18 MeV. The isotopically enriched ^{84}Kr target was contained in a gas cell with no entrance window. Excitation energies and angular distributions were obtained for 16 levels up to 2735 keV excitation energy in $^{83}_{36}Kr_{47}$. A distorted-wave analysis was used to determine l values and spectroscopic strengths. The pickup of neutrons from 1*g*, 2*p*, and 1*f* orbitals was observed. (auth)

27663 MECHANISMS OF HEAVY-ION INDUCED (p,n) — AND (n,p) —TYPE REACTIONS. Weisfield, M.W.; Williams, R.A.; Caretto, A.A. Jr. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 13: No. 1, 128-132 (Jan 1976).

Excitation functions and recoil ranges for the reactions $^{65}Cu(^{12}C,X)^{65}Zn$ and $^{65}Cu(^{11}B,X)^{65}Zn$ were measured for ^{12}C ion energies between 43 and 122 MeV and for ^{11}B ion energies between 60 and 115 MeV. The angular distribution for the production of ^{65}Zn by the $^{65}Cu(^{12}C,X)^{65}Zn$ reaction was determined at 88.6 MeV. The forward projected recoil ranges are not in satisfactory agreement with ranges which would be predicted on the basis of the complete fusion compound nucleus mechanism nor apparently with a simple kinematic treatment of the quasielastic scattering model. The experimental results appear to be consistent with a charge-exchange or nucleon transfer mechanism in which the distance of closest approach varies inversely with incident energy. Evidence for the enhancement of isospin $\Delta T = 0$ transitions to target analog states is suggested in that only an upper limit could be placed on the production of cross sections of ^{65}Ni, a $\Delta T \neq 0$ product, compared to high yields for ^{65}Zn, a $\Delta T = 0$ product. (auth)

27664 CHARGED PARTICLE Q-VALUE MEASUREMENTS IN THE IRON REGION. Jolivette, P.L.; Goss, J.D.; Bieszk, J.A.; Hichwa, R.D.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 13: No. 1, 439-439 (Jan 1976).

Q values are reported for the 11 reactions $^{63,65}Cu,^{64,66}Zn$, $^{70}Ge(p,\alpha)$; $^{46,48,50}Ti(d,p)$; $^{50}Cr,^{64}Zn(d,t)$, and $^{54}Fe(d,\alpha)$. Uncertainties range from ± 0.8 to ± 2.2 keV. Only the $^{50}Cr(d,t)^{49}Cr$ value differs greatly (61 keV) from the values in the 1971 Atomic Mass Evaluation, but in nine cases uncertainties were reduced by factors ranging from 1.5 to 6. The $Ti(d,p)$ measurements are consistent with (n,γ) values. (auth)

27665 LEVELS OF ^{83}Kr POPULATED IN THE DECAY OF ^{83}Rb AND ^{83}Br. Väisälä, S. (Laboratory of Physics, The Helsinki University of Technology, Otaniemi, Finland); Graeffe, G.; Heinonen, J.; Delucchi, A.A.; Meyer, R.A. Phys. Rev. C 13: No. 1, 372-376 (Jan 1976).

The levels of ^{83}Kr were studied from the decay of both ^{83}Rb and ^{83}Br. Thirteen γ rays were observed in the decay of ^{83}Rb and eight in the decay of ^{83}Br. The ground-state $M2$ transition from the 562-keV level was observed to have a branching ratio of 1.4×10^{-4}. The conversion coefficients were measured for the 9.39 keV and for the 32.2-keV transition. Decay schemes are presented and the possible spins, parities, and structure for the levels of ^{83}Kr are discussed. (auth)

27666 LIFETIME MEASUREMENTS TO TEST THE COEXISTENCE OF SPHERICAL AND DEFORMED SHAPES IN ^{72}Se. Hamilton, J.H.; Crowell, H.L.; Robinson, R.L.; Ramayya, A.V.; Collins, W.E.; Ronningen, R.M.; Maruhn-Rezwani, V.; Maruhn, J.A.; Singhal, N.C.; Kim, H.J.; Sayer, R.O.; Magee, T.; Whitlock, L.C. (Physics Department, Vanderbilt University, Nashville, Tennessee 37235). Phys. Rev. Lett. 36: No. 6, 340-342 (9 Feb 1976).

Mean lives of the 4^+ to (12^+) yrast states in ^{72}Se populated in the reaction $^{58}Ni(^{16}O,2p)$ were extracted from a line-shape analysis of the Doppler-broadened lines. The results strongly support the interpretation of the crossing of states built on near-spherical and deformed shapes in the yrast cascade. A least-squares fit of a collective Hamiltonian to the experimental data yielded a potential energy surface with spherical and strongly deformed prolate minima. (auth)

27667 NUCLEAR DATA SHEETS FOR A equals 69. Auble, R. L. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 17: No. 2, 193-224(Feb 1976).

Nuclear structure data available through September 1975 are compiled, and adopted level properties are given. The bulk of the data are presented pictorially for easy comparisons. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the compilers for maintenance and updating of the computer file. (auth)

27668 NUCLEAR STRUCTURE OF LOW-LYING 0^+ STATES IN Ge AND Se ISOTOPES. Loebner, K. E. G. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department); Dannhaeuser, G.; Donahue, D. J.; Haeusser, O.; Hershberger, R. L.; Lutter, R. (Muenchen Univ. (F. R. Germany). Sektion Physik); Klinger, W.; Witthuhn, W. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Physikalisches Inst.). Z. Phys., A; 274: No. 3, 251-257(1975).

6 figs.; 2 tabs.; 30 refs.

The following meanlives of levels in ^{72}Se have been measured using the recoil-distance Doppler-shift method: $\tau(2^+, 862\text{ keV}) = 3.1$ ps, $\tau(2^{+\prime}, 1{,}317\text{ keV}) = 12.5$ ps, $\tau(4^+, 1{,}638\text{ keV}) = 1.2$ ps and $\tau(6^+, 2{,}469\text{ keV}) < 0.7$ ps. These meanlives yield six B(E2) values which are discussed together with the known data of the depopulation of the excited $0^{+\prime}$ state at 937 keV. Systematics of $0^{+\prime}$ states in the mass region $70 \lesssim A \lesssim 100$ show that the low excitation energy of the $0^{+\prime}$ states is correlated with subshell closures. This suggests that the previous interpretation of the $0^{+\prime}$ state in ^{72}Se as a rotational band head is questionable. (DE)

27669 SCATTERING OF FILTERED NEUTRONS. Zaretskii, D. F.; Sirotkin, V. K.; Urin, M. G. (Moscow Engineering-Physics Inst.). Yad. Fiz.; 22: No. 4, 709-719(Oct 1975). (In Russian)

The problem is considered of interaction of neutrons, having penetrated through a filter, with target nuclei of the matter of the filter. Differences between the total and differential cross sections for filtered and non-filtered neutrons are calculated. The difference of the differential cross sections for elastic scattering of neutrons with energy of 1.8 MeV on nuclei ^{56}Fe and ^{208}Pb is calculated using the optical model. The obtained results are compared with the experimental data. It is shown that measurement of the difference for the elastic scattering cross sections enables one to determine the neutron strength functions. 1 figure. (auth)

27670 ENERGY DEPENDENCE OF THE PARAMETERS OF THE STRONG ABSORPTION MODEL FOR THE SCATTERING OF α PARTICLES. Burtebaev, N. T.; Duisebaev, A. D.; Ivanov, G. N.; Pavlova, N. N.; Yushkov, A. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 35-40(1974). (In Russian)

The elastic and inelastic scattering of α particles on $^{64,66,68,70}Zn$ was studied in the energy region from 29 to 50.5 MeV. It was established that the change in the values of the parameters of the strong absorption model with the energy does not agree with previously found semi-empirical equations, not taking into consideration the shell structure and a series of other characteristics of nuclear structure. It was shown that the parameters of the spatial structure of the nucleus (radius, surface thickness, and deformation) were slightly changed in the energy region studied. (tr-auth)

27671 FAST-NEUTRON TOTAL AND SCATTERING CROSS SECTIONS OF ELEMENTAL NICKEL. Guenther, P.; Smith, A.; Whalen, J. (Argonne National Lab., IL). Nucl. Sci. Eng.; 59: No. 2, 106-116(Feb 1976).

Fast-neutron total and scattering cross sections of elemental nickel are measured. Total neutron cross sections are determined from 0.25 to 5.0 MeV with incident neutron resolutions of a few keV. Differential neutron elastic scattering cross sections are measured from incident energies of 0.3 to 4.0 MeV at intervals of less than or equal to 200 keV. Cross sections for the neutron excitation of states at 1.156 +- 0.015, 1.324 +- 0.015, 1.443 +- 0.015, 2.136 +- 0.013, 2.255 +- 0.030, 2.449 +- 0.030, 2.614 +- 0.020, and 2.791 +- 0.025 MeV are determined to incident energies of 4.0 MeV. The experimental results are examined in the context of optical and statistical models including resonance width-fluctuation and correlation effects. The present experimental results are compared with previously reported measured values and with the evaluated data file ENDF/B-IV. 6 figures, 1 table. (auth)

27672 BLOCKING MEASUREMENTS OF NUCLEAR DECAY TIMES. Gibson, W. M. (Bell Labs., Murray Hill, NJ). Annu. Rev. Nucl. Sci.; 25: 465-508(1975).

After an examination of the relationship of blocking measurements to other types of lifetime measurements, the technique is discussed, citing typical examples. The analysis of lifetime data is considered using single-string continuum calculations, Monte Carlo simulations, and multistring continuum calculations. Use of the technique in resonance reactions, fission, inelastic scattering, and compound-elastic scattering is illustrated. 21 figures, 3 tables, 72 figures. (SDF)

Nuclear Properties and Reactions, $90 \leq A \leq 149$

Refer also to abstracts 27593, 27613, 27615, 27642, 27657, 27659, and 27660.

27673 (CEA-N-1817(suppl.), pp 2-6) GRENOBLE FUNDAMENTAL RESEARCH DEPARTMENT. Supplement to Semi-Annual Bulletin No. 7, January–June 1975. ILL Experiments. Gautheron, J. P.; Ristori, Ch.; Crancon, J.; Asghar, C.; Kratz, R. 1975. (In French)

In Grenoble Fundamental Research Department. Semi-annual bulletin No. 7, January-June 1975. ILL Experiments. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale).

The Lohengrin spectrometer was used for an on-line detection of neutron precursors with a half-life longer than 0.2 sec. Seven new isotopes were discovered: ^{91}Se, ^{94}Kr, ^{99}Sr, ^{99}Y, ^{134}Sn, ^{137}Te, and ^{138}Te. The half-lives were measured and the neutron emission probability written in % of the total β decay of the precursor nucleus. (FR)

27674 (IAEA-169(Vol. 3), pp 3 v.; v. 3 p. 325-328) NEW MEASUREMENTS OF GAMMA-RAY EMISSION PROBABILITIES OF FISSION PRODUCT NUCLIDES IMPORTANT FOR NONDESTRUCTIVE FUEL ANALYSIS. Debertin, K.; Schoetzig, U.; Walz, K. F.; Weiss, H. M. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Nuclear data of medium and long-lived fission products are known with an accuracy generally sufficient in most application fields. An exception are γ-ray emission probabilities which have relative uncertainties of 3% and more for a number of important cases. An attempt to reach an accuracy of 1% for absolute γ-ray emission probabilities is described. (auth)

27675 (JUL-1218) γ-SPECTROSCOPIC STUDIES ON ^{105}Ru. Gueven, H. H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik; Koeln Univ. (F. R. Germany)). Jul 1975. 69p. (In German). INIS.

30 figs.; 14 tabs.; 80 refs.

The γ-radiation emitted after the absorption of thermal neutrons in ^{104}Ru was measured in order to complete the present level and γ-decay scheme of ^{105}Ru and to determine the spins of the states, multipolarities and mixed ratios of the electromagnetic radiation in the transition between these states. γ-single spectra, γ-γ-coincidences and γ-γ-angular correlations were measured for this purpose. By means of the present data, an attempt is made to interpret a part of the ^{105}Ru states within the framework of the shell model, of the core excitation model and the rotation model. (DE)

27676 CRITICAL ASYMMETRY AND THE SYSTEMATICS OF FISSION-LIKE PROCESSES IN THE REACTIONS OF ^{12}C PROJECTILES WITH MEDIUM MASS NUCLEI. Natowitz, J.B.; Namboodiri, M.N.; Chulick, E.T. (Cyclotron Institute and Department of Chemistry, Texas A & M University, College Station, Texas 77843). Phys. Rev. C 13: No. 1, 171-181 (Jan 1976).

The systematics of fission-like processes observed in reactions induced by 107- and 197-MeV ^{12}C projectiles have been investigated. Counter telescopes were employed to detect and identify the products of reactions with ^{89}Y, ^{98}Mo, Ag, and ^{116}Sn. Limited experiments using Ni and Au targets were also performed. For the medium mass targets, cross sections, energy distributions, and angular distributions of the reaction products are reported. Limiting angular momenta for the fusion of ^{12}C with Y, Mo, and Ag have been determined and are used to estimate the angular momenta of the collisions leading to fission-like reactions. The probability of occurrence of such reactions is compared with predictions based upon the concept of an angular momentum dependent critical asymmetry. This concept is found to be very useful in discussing the reaction mechanisms involved. (auth)

27677 DELAYED-NEUTRON ACTIVITIES PRODUCED IN FISSION: MASS RANGE 79-98. Rudstam, G.; Lund, E. (Swedish Research Councils' Laboratory, Studsvik, Fack, S-611 01 Nyköping, Sweden). Phys. Rev. C 13: No. 1, 321-330 (Jan 1976).

A sensitive neutron counter has been used for a study of delayed-neutron emission from mass-separated fission products. Five new delayed-neutron precursors, ^{79}(Zn,Ga), ^{80}Ga, ^{81}Ga, ^{82}Ga, and ^{83}Ga, have been found, and the half-life determination for seven other precursors has been improved. (auth)

27678 MULTISTEP PROCESSES IN THE INELASTIC SCATTERING OF 70.4-MeV ^{12}C PROJECTILES FROM ^{144}Nd. Hillis, D.L.; Gross, E.E.; Hensley, D.C.; Rickertsen, L.D. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Bingham, C.R.; Scott, A.; Baker, F.T. Phys. Rev. Lett. 36: No. 6, 304-306 (9 Feb 1976).

Inelastic scattering of ^{12}C projectiles from ^{144}Nd has been studied at an incident energy of 70.4 MeV. The differential cross sections for exciting low-lying collective states of the target and projectile are compared to distorted-wave Born-approximation (DWBA) and coupled-channels calculations. Standard DWBA calculations using known Coulomb matrix elements fail to fit the data. Coupled-channels calculations, however, can account for these data and show a strong sensitivity to target and projectile reorientation matrix elements. (auth)

27679 NUCLEAR DATA SHEETS FOR A equals 132. Hiddleston, H. R.; Browne, C. P. (Univ. of Notre Dame, IN). Nucl. Data Sheets; 17: No. 2, 225-286(Feb 1976).

All information concerning nuclei with A equals 132 received prior to January 1975 has been evaluated and compiled. This report supersedes the 1961 version of Nuclear Data Sheets for A equals 132. (auth)

27680 INTERNAL IONIZATION ACCOMPANYING K CONVERSION: ONE-STEP THEORY. Mukoyama, T.; Shimizu, S. (Institute for Chemical Research and Radioisotope Research Center, Kyoto University, Kyoto, Japan). Phys. Rev. C 13: No. 1, 377-386 (Jan 1976).

A one-step theory of internal ionization accompanying K conversion has been developed. The ionization probability and the energy spectrum of the ejected electrons have been calculated using screened relativistic hydrogenic wave functions. It is shown that the probabilities calculated using the present model are in good agreement with the recent experimental values for the K-shell internal ionization accompanying K conversion. The calculated results predict that the ionization probability is dependent on the nuclear transition energy and on the multipolarity of the transition. The multipolarity dependence of the spectral shape of the ejected electrons has also been studied. (auth)

27681 STATES IN ^{126}Sb POPULATED IN THE β DECAY OF 10^5-yr ^{126}Sn. Smith, H.A. Jr.; Bunker, M.E.; Starner, J.W.; Orth, C.J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Löbner, K.E.G. Phys. Rev. C 13: No. 1, 387-398 (Jan 1976).

The low-energy level structure of the odd-odd nucleus ^{126}Sb has been investigated by studying the radioactive decay of 10^5-yr ^{126}Sn, using Ge(Li) and Si(Li) detectors. Based on conversion-electron and γ-ray singles data, γ-γ and γ-e^- prompt and delayed coincidence measurements, and complementary γ-ray energy and intensity balance arguments, a decay scheme for ^{126}Sn has been deduced which accommodates all of the observed γ-ray transitions. The energies (keV), spins, and parities of the levels established in ^{126}Sb are as follows: 0.0 [8$^-$], 17.7 [5$^+$], 40.4 [3$^-$], 83.1 [4$^-$, (3$^-$)], 104.7 [3$^+$], and 128.0 [2$^+$]. The respective half-lives of these six states are: 12.4 day, 19.0 min, $\simeq$11 s, 5.1 ns, 553 ns, and 78.0 ns, the latter four values having been determined in the present investigation. The level assignments are discussed within the framework of the single-particle shell model and in relation to the proposed assignments of low-lying energy levels of neighboring odd-odd antimony isotopes. (auth)

27682 CALCULATIONS IN THE $50 < N, Z < 82$ REGION WITH AN INTERACTION DERIVED FROM THE TABAKIN POTENTIAL. de Takacsy, N.; Das Gupta, S. (Physics Department, McGill University, P. O. Box 6070, Station "A", Montreal, Quebec, Canada H3C 3G1). Phys. Rev. C 13: No. 1, 399-411 (Jan 1976).

The region of the periodic table with $50 \leq Z, N \leq 82$ is studied using fixed single particle energies and a semirealistic effective interaction derived from the Tabakin potential. All the free parameters are determined by fitting the data on the odd-mass Sn isotopes and $N=82$ isotones. A conventional quasiparticle formalism is then used to study the structure of a range of spherical nuclei near the $N=82$ and the $Z=50$ magic numbers. A deformed Hartree-Fock plus BCS method is used to obtain the structure and electromagnetic properties of deformed nuclei, particularly the neutron-deficient even Ba isotopes. Prolate deformation is found to be favored. In the Ba isotopes, although neutrons have BCS correlation, the protons develop an energy gap between occupied and unoccupied orbitals due to the Hartree-Fock field itself. The proton orbitals are then tested through spectroscopic calculations in La isotopes. Both for spherical and deformed nuclei, agreement between theory and experiment is very satisfactory. (auth)

27683 HINDERED BETA DECAY OF ^{93}Nb^m AND THE DECAY SEQUENCE ^{93}Zr$\rightarrow^{93}$Nb$^{m,g}\rightarrow^{93}$Mo. Hopke, P.K.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. C 13: No. 1, 434-436 (Jan 1976).

A study of the decay of ^{93}Nb^m has revealed hindered β decay to known levels in ^{93}Mo at (log ft value in parentheses): 204.12 (9.36), 786.19 (9.11), 820.61 (10.6), and 1039.25 keV (> 10.2). The β transitions to these levels are found to be 2 to 3 orders of magnitude slower than those observed in the decay of ^{93}Tc^m. This difference is discussed in terms of the shell model states available to ^{93}Nb, ^{93}Mo, and ^{93}Tc. (auth)

27684 ACCURATE DETERMINATION OF M1-E2 MIXING RATIO AND NUCLEAR STRUCTURE PARAMETER OF THE 39.58 keV TRANSITION IN ^{129}Xe. Puri, V. S.; Sahota, H. S.; Khurana, C. S. (Punjabi Univ., Patiala, India). Curr. Sci. (India); 45: No. 1, 16(5 Jan 1976).

27685 CHOICE OF γ-RAY SOURCES FOR COMPTON PROFILE STUDIES. Chaddah, P.; Sahni, V. C. (Bhabha Atomic Research Centre, Bombay). Phys. Status Solidi (a); 32: No. 2, 677-682(16 Dec 1975).

A careful study is made of the different factors governing the choice of a γ-ray source, and other experimental parameters (scattering angle, collimation) when performing a Compton

scattering experiment using a solid state detector. As is known, the poorer penetration of lower energy γ-rays leads to a lower count rate. It is found that an optimum choice of scattering angle and collimation can, in many cases, substantially offset this effect. A detailed comparison of the two sources most commonly used, viz. ^{241}Am and ^{123m}Te, is made. It is shown in contrast to what has been previously reported in literature that ^{241}Am can be quite a worthwhile choice. Some errors in previous findings are also pointed out. (auth)

27686 INTERNAL CONVERSION COEFFICIENT α_L OF THE 10 keV TRANSITION IN ^{137}La. Piticu, I.; Enulescu, A. L.; Vata, I.; Protop, C.; Constantinescu, F. L. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 20: No. 8, 863-868(1975).

The α_L −ICC measurement of the 10-keV transition in ^{137}La is presented, and some comments on it are made. (auth)

27687 MEASUREMENT AND ANALYSIS OF 6.9-MeV ELASTIC PROTON SCATTERING BY PALLADIUM ISOTOPES. Egoshin, V. G.; Kashuba, I. E.; Lylo, V. V.; Palkin, G. P.; Prokopenko, V. S.; Saltykov, L. S.; Stryuk, V. S.; Chirko, V. I. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 12, 1988-1992(Dec 1975). (In Russian).

The angular dependences of relative differential cross sections are measured for 6.9 MeV elastic proton scattering by six palladium isotopes. Experimental results were analyzed by the optical model. The energetic structure of palladium nuclei is considered on the basis of the phenomenological collective model. (auth)

27688 DECAY OF 14.6 h ^{90}Nb. Pakkanen, A.; Kortelahti, M.; Helppi, H.; Kantele, J.; Poikolainen, T.; Komu, R. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Z. Phys., A; 274: No. 2, 127-129(1975).

2 figs.; 2 tabs.; 13 refs.

The disintegration of 14.6 h ^{90}Nb produced by bombarding natural Zr with 13 MeV protons was investigated by methods of γ-ray spectrometry. Results from singles, coincidence and anti-Compton spectrometer measurements are reported. A decay scheme is proposed including excited states in ^{90}Zr at 1,761, 2,186.4, 2,319.1, 2,739.4, 2,747.9, 3.077.0, 3,448.2, 3,589.5, 3,977.1, 4,232.4, 4,319.5, 4,375.4, 4,541.6, 5,060.0, 5,164.6 and 5,432.9 keV. More than 10 γ-ray transitions and several levels proposed in an earlier investigation are shown to be in error. (DE)

27689 THE RATIO OF THE QUADRUPOLE MOMENTS OF THE ISOTOPES ^{95}Mo AND ^{97}Mo. Kaufmann, J.; Kronenbitter, J.; Schwenk, A. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys., A; 274: No. 2, 87-90(1975).

2 figs.; 8 refs.

The spin-lattice relaxation times T_1 of the NMR signals of ^{95}Mo and ^{97}Mo in aqueous K_2MoO_4 solutions were determined by the inversion recovery technique. To separate the relaxation rates due to electric quadrupole interaction and due to magnetic dipole interaction, pure H_2O and mixtures of H_2O and D_2O were used as solvent. No dependence of the ratio of the relaxation rates $T_1(^{95}Mo)/T_1(^{97}Mo)$ on the composition of the solvent was detected, i.e. the relaxation due to magnetic dipole interaction may be neglected. From the ratio of the relaxation rates the absolute value of the ratio of the quadrupole moments of the molybdenum isotopes was evaluated: $Q(^{97}Mo)/Q(^{95}Mo) = 11.4$. (DE)

27690 NUCLEAR MOMENTS AND OPTICAL ISOTOPE SHIFTS OF ^{108m}Ag and ^{110m}Ag. Fischer, W.; Huehnermann, H.; Meier, T. (Marburg Univ. (F. R. Germany). Fachbereich Physik). Z. Phys., A; 274: No. 2, 79-85(1975).

3 tabs.; 4 figs.; 31 refs.

The hyperfine structure of the resonance lines of ^{108m}Ag and ^{110m}Ag has been investigated by means of optical interference spectroscopy. The metastable isotopes were produced by neutron irradiation in a reactor. From the measured a- and b-values the value for the nuclear magnetic dipole moment of ^{108m}Ag and the values for the electric quadrupole moments are derived. The measured isotope shifts allow the determination of the changes in the mean square charge radii of the nuclei involved. (DE)

27691 STATES IN N = 80 ^{140}Nd POPULATED IN THE DECAY OF ^{140}Pm. Kennedy, G. G.; Gujrathi, S. C.; Mark, S. K. (McMill Univ., Montreal, Quebec (Canada). Foster Radiation Lab.). Z. Phys., A; 274: No. 3, 233-239(1975).

6 figs.; 3 tabs.; 22 refs.

The level structure of the N = 80, ^{140}Nd has been investigated through the beta decay of ^{140m}Pm and ^{140g}Pm, whose decay half-lives were measured to be 5.95 min and 9.1 sec, respectively. Decay schemes for the two isomers have been constructed from γ-ray measurements. With the help of the beta decay ft values and internal conversion electron measurements, spins and parities were deduced for levels in ^{140}Nd. Among the levels a 7^- state at 2,222.0 keV and a 5^- state at 2,273.3 keV are identified as two-neutron quasiparticle states. The J^π for ^{140}Pm and ^{140g}Pm have been deduced as 7^- and 1^+, respectively. From beta end-point measurements, the decay energies of the two isomers have been determined as $Q_{EC} = 6.48$ MeV ^{140m}Pm and $Q_{EC} = 6.08$ MeV ^{140g}Pm. The results are discussed in the light of nuclear systematics of the N = 79 and 80 isotones. (DE)

27692 ISOSCALAR TRANSITION RATES FROM FOLDING MODEL ANALYSES OF (α,α') SCATTERING. Gils, H. J.; Rebel, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Z. Phys., A; 274: No. 3, 259-266(1975).

4 figs.; 3 tabs.; 40 refs.

The folding model approach has been used for extracting isoscalar transition rates from inelastic α-particle scattering cross sections. The procedure is demonstrated by several cases based on measurements in $E_\alpha = 104$ MeV. Some implications of the method and the significance of the size and shape information of the results are discussed. (DE)

27693 LIFETIMES OF ROTATIONAL LEVELS OF ^{160}Yb. Bochev, B.; Karamyan, S. A.; Kutsarova, T.; Subbotin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 4, 665-669(Oct 1975). (In Russian)

The lifetimes of the $8 \rightarrow 6$, $6 \rightarrow 4$, $4 \rightarrow 2$ and $2 \rightarrow 0$ groundband transitions in ^{160}Yb and feeding time for population of the band have been measured by a recoil-distance Doppler-shift method following (^{40}Ar, 4n) reaction. Deviations in the deduced B(E2) values from rotational behavior are discussed. 2 figures, 1 table. (auth)

27694 NUCLEAR STATES OF ^{109}Ag AND ^{111}Ag. El-Bedewi, F.; Miligy, Z.; Hanafi, H. (Ain Shams Univ., Cairo). Acta Phys. Acad. Sci. Hung.; 38: No. 2, 153-177(1975).

Gamma ray spectra associated with the decay of ^{109}Pd and ^{111m}Pd have been studied with Ge(Li) and Ge(Li)−NaI(Tl) spectrometers. Thirty-six gamma rays including five new transitions are identified in the ^{109}Pd decay and placed in a level scheme involving two new excited states in ^{109}Ag at 697 ± 0.9 and 811 ± 1.0 keV beside twelve known states. Directional angular correlation measurements have also been carried out and the spins of states of energies greater than 415 keV have been determined together with related multipolarities and mixing ratios. For the ^{111m}Pd decay, 91 gamma rays including 17 new transitions are observed. The deduced level scheme of ^{111}Ag is found to involve 25 excited states from which five levels at 1351 ± 0.6, 1632 ± 0.4, 1764 ± 0.5, 2060 ± 0.5 and 2167 ± 0.5 keV are considered to be new. Previously reported states at 1781.6, 1933.9 and 1964.6 keV are not confirmed. Spin and parity assignments for the various observed levels are suggested. 7 figures, 7 tables. (auth)

27695 ENERGY LEVELS IN ^{143}Pr. Darwish, D. A. E.; Miligy, Z.; Abou-Leila, M. A. (Ain Shams Univ., Cairo). Acta Phys. Acad. Sci. Hung.; 38: No. 2, 137-152(1975).

The decay of ^{143}Ce to levels in ^{143}Pr has been studied using Ge(Li) and Na(Tl)−Ge(Li) coincidence spectrometers. Single gamma-ray spectrum as well as gamma-gamma coincidence and directional angular correlation measurements were carried out to determine gamma transitions, multipolarities, mixing ratios and level spins and parities. Ten new transitions and 26 previously known transitions were observed having energies up to 1340 keV. An energy level scheme has been constructed for ^{143}Pr composed of 12 previously established levels together with two new levels at 890 keV ($5/2^+$) and 1314 keV ($3/2^-$, $5/2^-$). Angular correlation measurements together with log ft values led to assigned spins and parities for the levels 350 keV ($3/2^-$) 721.8 keV ($1/2^+$), 890 keV ($5/2^+$) and 937.3 keV ($3/2^+$, $5/2^+$). 4 figures, 4 tables. (auth)

27696 DECAY OF ^{131g}Te AND ^{131m}Te TO ^{131}I LEVELS. Miligy, Z.; Darwish, D. A. E.; Eid, S. A. (Ain Shams Univ., Cairo). Acta Phys. Acad. Sci. Hung.; 38: No. 2, 123-135(1975).

The gamma rays emitted in the decay of ^{131g}Te and ^{131m}Te to levels in ^{131}I were investigated by means of a Ge(Li) spectrometer. The energies and intensities of 78 gamma-rays were determined from the gamma-ray singles spectra. Of these, 21 gamma-transitions reported for the first time in the present work are identified to ^{131}I. A new level not reported before has been proposed at 1854 keV excitation energy. Two-parameter γ−γ coincidence experiments with Ge(Li) and NaI(Tl) detectors have been performed. The resolving time of the fast coincidence circuit was 50 nsec. A level scheme has been constructed for ^{131}I on the basis of energy, intensity and coincidence measurements. The most probable spins and parities, values of mixing parameters and multipolarities of γ rays were determined from gamma-gamma directional angular correlation measurements and log ft values. The results of spin assignment to some levels in ^{131}I from the present work are summarized in the following, where the level energy is in keV followed by the

spin and parity as (J^π): 590 ($9/2^+$, $5/2^+$); 603 ($5/2^+$); 773.7($9/2^+$); 877 ($1/2^+$); 1065 ($9/2^+$); 1188 ($1/2^+$); 1315 ($9/2^+$); 1556.4 ($9/2^+$); 1596.5 ($11/2^+$); 1646 ($9/2^-$); 1797 ($11/2^-$, $13/2^-$); 1854 ($9/2^-$, $11/2^-$, $13/2^-$); 1888 ($9/2^-$, $11/2^-$); 1899 ($9/2^-$); 1980 ($11/2^-$); 2001 ($9/2^-$); 2118 ($9/2^-$, $11/2^-$, $13/2^-$); 2231 ($13/2^-$); 2240 ($9/2^-$, $11/2^-$) and 2330 ($9/2^-$, $11/2^-$). 4 figures, 3 tables.

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 27356, 27385, 27613, 27615, 27674, and 27680.

27697 N=85 NUCLEI. I. DECAY OF ^{145}Pr TO LEVELS OF ^{145}Nd. Jackson, S.V.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. C 13: No. 1, 339-347 (Jan 1976).

A γ-ray spectroscopy study of the decay of ^{145}Pr has led to the identification of 61 γ rays. These and γ-γ coincidence studies have been used to identify 20 levels in ^{145}Nd at (J^π value in parentheses): ground state (7/2⁻), 67.1 (3/2⁻), 72.50 (5/2⁻), 657.67 (11/2⁻), 748.28 (9/2⁻), 780.45 (3/2⁻), 919.9 (1/2⁻), 920.72 (9/2⁻), 937.05 (5/2⁻), 1011.22 (11/2⁻), 1051.41 (7/2⁻), 1085.2 (3/2⁺), 1150.26 (9/2⁺), 1101.05 (5/2⁻), 1161.05 (5/2⁻), 1162.32 (−), 1249.7 (5/2⁻), 1285.6 (−), 1338.6 (−), 1403.92 (5/2⁻), and 1527.05 (9/2⁻) keV. These levels and their properties are discussed in terms of the clustering and the dressed n-quasiparticle model. (auth)

27698 MOMENTS OF INERTIA IN ^{162}Yb AT VERY HIGH SPINS. Simon, R.S.; Banaschik, M.V.; Colombani, P.; Soroka, D.P.; Stephens, F.S.; Diamond, R.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 36: No. 7, 359-361 (16 Feb 1976).

Two methods have been used to obtain values of the effective moment of inertia of very-high-spin (20ħ–50ħ) states populated in heavy-ion compound-nucleus reactions. The ^{162}Yb nucleus studied has effective moments of inertia smaller than, but approaching, the rigid-body estimate. (auth)

27699 NUCLEAR DATA SHEETS FOR A equals 179. Henry, E. A. (Univ. of California, Livermore). Nucl. Data Sheets; 17: No. 2, 287-328(Feb 1976).

Nuclear data for the 10 known members of the A equals 179 mass chain are compiled. Included in the compilation are drawings presenting most of the experimental data. Summary Sheets showing adopted level and gamma-ray properties, and Data Sheets tabulating the experimental data. Also included are data on the alpha decay of members of the A equals 183 mass chain. For brevity, gamma-gamma-coincidence data and some reaction results are presented only on the drawings. This compilation is based on references received before June 1975. Substantial detail is known for the level structures of ^{179}Hf, ^{179}Ta, ^{179}W, and, to a lesser extent ^{179}Re. The levels of ^{179}Hf are well studied by beta decay, (n,gamma) reactions, and isomer decay. The charged-particle reactions leading to levels in ^{179}Hf lack definitive l-transfer values. Beta decay and in-beam gamma-ray spectroscopy which populate levels in ^{179}Ta and ^{179}W are reported. Levels in ^{179}Re have been studied by in-beam gamma-ray spectroscopy. Beta decay of ^{179}Os to levels in ^{179}Re is now being studied. Nothing is known about excited levels in ^{179}Lu, ^{179}Os, ^{179}Ir, ^{179}Pt, ^{179}Au, or ^{179}Hg. (auth)

27700 MULTIPOLE MIXING RATIOS OF TRANSITIONS IN ^{175}Lu POPULATED FROM THE DECAY OF ^{175}Hf. Quinones, L. M.; Behar, M.; Grabowski, Z. W. (Purdue Univ., Lafayette, Ind. (USA). Tandem Accelerator Lab.); Cambiaggio, M. C.; Garcia Bermudez, G.; Hernandez, E. S. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Z. Phys., A; 274: No. 2, 173-178(1975).

2 figs.; 3 tabs.; 28 refs.

Electron capture decay of ^{175}Hf(70 d) provides a possibility for unambiguous determination of the sign and magnitude of multipole mixing ratios for 89 keV and 114 keV transitions in ^{175}Lu. This is because both gamma rays are in coincidence with the 230 keV transition which is of a pure E2 character. The results of the γ-γ directional correlation measurements, in terms of E2/M1 mixing ratios delta, are given. In addition the directional correlation measurements of the 89 γ − 343 γ and 319 γ − 114 γ cascades yield $\text{delta}_{343} = 0.08$ and $\text{delta}_{319} = -0.152$. (DE)

27701 INTERACTION OF SLOW NEUTRONS WITH Os AND Pt ISOTOPES. Vertebnyi, V. P.; Vorona, P. N.; Kal'chenko, A. I.; Pshenichnii, V. A.; Rudishin, V. K. Yad. Fiz.; 22: No. 4, 674-678(Oct 1975). (In Russian)

The isotopic behavior of the level density has been studied using the WWR-M of Kiev Institute for Nuclear Research to obtain the information on the interaction of neutrons with the $^{186-192}$Os and $^{190-198}$Pt isotopes in the thermal and resonance energy region. The mean values of the compound nucleus parameters are presented. The mean level spacings for those isotopes, being reduced to 6.5 MeV excitation energy, have their minimum values in the region N = 114−116 which is an intermediate region between rare earth and N = 126 nuclei. 6 tables, 2 figures. (auth)

27702 EMISSION OF HIGH-ENERGY DEUTERONS, TRITONS, AND HELIUM ISOTOPES IN NUCLEAR SPALLATION. Takibaev, Zh. S.; Toktarov, K. A.; Morozova, P. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 1-5(1974). (In Russian)

The characteristics of the emission of high energy deuterons, tritons, and helium nuclei with a kinetic energy greater than 25 MeV/nucleon, formed during the spallation of heavy nuclei with ion energies of 7.5 to 60 GeV, were studied. The formation cross section of these fragments and their angular distributions were determined. The Butler-Pearson model for the formation of high energy deuterons and tritons was examined. Its comparison with experimental data showed that the value of the optical potential $|V_0| = 25 \pm 5$ MeV does not explain all experimental data; in the low momentum region systematic divergence of the theory from experiment was observed. (tr-auth)

27703 REDUCED PROBABILITIES OF E2 TRANSITIONS AND QUADRUPOLE MOMENTS IN THE MODIFIED COLLECTIVE MODEL. Bravin, A. V.; Sinichkin, V. P.; Tereshin, Yu. V. (Saratov State Univ., USSR). Yad. Fiz.; 22: No. 5, 957-964(Nov 1975). (In Russian)

The formula for reduced probabilities of E2 transitions and for mean values of the quadrupole momenta are obtained in the general form in the framework of the modified collective model. The calculation results are analyzed for the ground rotational band. The results are compared with the experimental data. 3 tables, 1 figure. (auth)

27704 SYMMETRY FEATURES OF COLLECTIVE STATES OF DEFORMED NUCLEI. Dzholos, R. V.; Denau, F.; Yanssen, D. (Joint Inst. of Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 5, 965-974(Nov 1975). (In Russian)

The collective Hamiltonian built in the microscopic nuclear model is used to analyze the features of low-lying collective states of deformed nuclei ^{168,170,172}Yb and ^{174,176}Hf. It is shown that the SU (3) scheme gives a qualitative correct description of strongly deformed nuclei. Deviations from the scheme are analyzed. 4 figures, 3 tables. (auth)

27705 CALCULATIONS OF NUCLEAR ENERGIES USING THE ENERGY DENSITY FORMALISM. Pu, W. W. T. Denton, TX; North Texas State Univ. (1975). 85p. University Microfilms Order No. 76-4415.

Thesis (Ph. D.).

The energy density formalism (EDF) is used to investigate two problems. In this formalism the energy of the nucleus is expressed as a functional of its density. The nucleus energy is obtained by minimizing the functional with respect to the density. The first problem has to do with the stability of nuclei having shapes of different degrees of central depression (bubble shapes). It is shown that the bubble shapes are energetically favorable only for unrealistically large nuclei. Particularly, the super heavy nucleus that has been suggested (Z equals 114, N equals 184) prefers a shape with constant central density. These results are in good agreement with earlier calculations using the liquid drop model. The second problem reported here concerns an anomaly detected experimentally in the isotope shift of mercury. The isotope shifts among a long chain of mercury isotopes show a sudden change as the neutron number is reduced. In particular, the experimental result suggests that the effective size of the charge distributions of ^{183}Hg and ^{185}Hg are as large as that of ^{196}Hg. Such sudden changes in other nuclei have been attributed to a sudden onset of permanent quadruple deformation. In the case of mercury there is no experimental evidence for deformed shapes. It was, therefore, suggested that the proton distribution might develop a central depression in the lighter isotopes. The EDF is used to investigate the mercury isotope shift anomaly following the aforementioned suggestion. Specifically, nucleon densities with different degrees of central depression are generated. Energies corresponding to these densities are obtained. To allow for shell effects, nucleon densities are obtained from single-particle wave functions. Calculations are made for a few mercury isotopes, especially for ^{184}Hg. The results are that in all cases the energy is lower for densities corresponding to a solid spherical shape. Also for all isotopes of mercury, the energy is lower when the last two protons occupy the ^{3}s/sub 1/2/ level (instead of the ^{1}h/sub 11/2/ level). Based on the findings it can be concluded that a central depression in the lighter mercury isotopes does not appear to be a possible explanation for the isotope shift anomaly. (Diss. Abstr. Int., B)

27706 GAMMA-RAY TRANSITION PROBABILITIES IN DEFORMED NUCLEI. Andrejtscheft, W. (Zentralinstitut fuer Kernforschung, Dresden); Schilling, K. D.; Manfrass, P. At. Data Nucl. Data Tables; 16: No. 6, 515-579(Dec 1975).

Experimental data on absolute gamma-ray transition probabilities in deformed nuclei (150 less than A less than or equal to 190) are presented together with information on the initial and final states as well as energies, multipolarities, and total conversion coefficients of the transitions involved. For comparison with model predictions, Weisskopf and Nilsson hindrance factors, the latter with the pairing effect taken into account, are listed. Data available up to May 1975 have been included. 4 tables. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 26907, 27385, 27613, 27633, 27669, 27676, 27680, 27701, 27702, 27705, 27761, and 27772.

27707 (^{3}He,2p) REACTION ON ^{208}Pb. Gavron, A. (Department of Physics, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). Phys. Rev. C 13: No. 1, 98-104 (Jan 1976).

The angular distribution and relative energy of the proton pair emitted in the ^{208}Pb(^{3}He,2p) reaction was measured by a simple technique involving a single semiconductor telescope. The experimental results indicate that the final state interaction between the two protons is small when compared to the interaction between the target nucleus and each one of the protons. (auth)

27708 NEUTRON RESONANCE SPECTROSCOPY: ^{209}Bi. Singh, U.N.; Rainwater, J.; Liou, H.I.; Hacken, G. (Columbia University, New York, New York 10027); Garg, J.B. Phys. Rev. C 13: No. 1, 124-127 (Jan 1976).

Neutron total cross section vs energy measurements were made for several thicknesses of bismuth metal. The results of the resonance parameter evaluation for 30 levels (12 s and 18 p) to 75 keV are given. Parameters for the p levels, and for three weak s levels were determined using a transmission area analysis. An R-matrix multilevel shape analysis fitting was used to obtain the final choice resonance parameters for the nine dominant l=0 levels. The experimental points and R-matrix fit curve to 75 keV are shown. The (E_0,J,Γ_n) choices for these nine levels are (0.800, 5, 4.6), (2.312, 4, 19.5), (5.112, 5, 5.4), (12.15, 4, 270), (15.54, 4, 118), (27.08, 4, 24), (33.34, 4, 240), (45.58, 5, 160), and (69.18, 5, 520), where E_0 is in keV and Γ_n is in eV. On the basis of these levels, we obtain for the s and p strength functions $10^4 S_0 = (0.62^{+0.36}_{-0.20})$ and $10^4 S_1 = (0.13^{+0.06}_{-0.04})$. A channel radius of 9 fm was used to calculate S_1 and the evaluation ignores the possibility that some p levels were missed below 75 keV. (auth)

27709 ELASTIC SCATTERING OF ^{40}Ar AND ^{84}Kr ON ^{209}Bi AND ^{238}U AT 7.2 AND 8.5 MeV/N. Birkelund, J.R.; Huizenga, J.R. (Departments of Chemistry and Physics, University of Rochester, Rochester, New York 14627); Freiesleben, H.; Wolf, K.L.; Unik, J.P.; Viola, V.E. Jr. Phys. Rev. C 13: No. 1, 133-146 (Jan 1976).

Cross sections for elastic scattering of ^{40}Ar on targets of ^{209}Bi and ^{238}U were measured at energies of 286 and 340 MeV. Cross sections for the elastic scattering of ^{84}Kr on ^{209}Bi were measured at energies of 600 and 712 MeV. These experimental elastic scattering data were fitted with optical and Fresnel models. The total reaction cross section deduced from the Fresnel model by the one-quarter point technique agrees within a few percent with the result from the optical model. The Fresnel interaction radius and the optical model strong absorption radius are found to be approximately equal and qualitatively reproduced by the sum of the half-density electron scattering radii of the two heavy ions and a constant of 3.2±0.3 fm. A method of estimating total reaction cross sections for heavy ions is presented. Some observations on the real and imaginary potentials of very heavy ions are presented. (auth)

27710 RELATIVISTIC CORRECTIONS TO THE ELASTIC ELECTRON SCATTERING FROM ^{208}Pb. Chandra, H. (Institut für Kernphysik der Universität Mainz, West Germany; Sauer, G. Phys. Rev. C 13: No. 1, 245-252 (Jan 1976).

In the present work we have calculated the differential cross sections for the elastic electron scattering from ^{208}Pb using the charge distributions resulting from various corrections. The point proton and neutron mass distributions have been calculated from the spherical wave functions for ^{208}Pb obtained by Kolb *et al.* The relativistic correction to the nuclear charge distribution coming from the electromagnetic structure of the nucleon has been accomplished by assuming a linear superposition of Gaussian shapes for the proton and the neutron charge form factor. Results of this calculation are quite similar to an earlier calculation by Bertozzi *et al.*, who have used a different wave function for ^{208}Pb and have assumed exponential smearing for the proton corresponding to the dipole fit for the form factor. Also in the present work, reason for the small spin orbit contribution to the effective charge distribution is discussed in some detail. It is also shown that the use of a single Gaussian shape for the proton smearing usually underestimates the actual theoretical cross section. (auth)

27711 RECOIL STUDIES OF NUCLEAR REACTIONS INDUCED BY HIGH-ENERGY PARTICLES. II. PRODUCTION OF ^{149}Tb BY 1- TO 300-GeV PROTONS ON ^{197}Au. Winsberg, L. (Department of Physics, University of Illinois at Chicago Circle, Chicago, Illinois); Weisfield, M.W.; Henderson, D. Phys. Rev. C 13: No. 1, 279-282 (Jan 1976).

The fraction of ^{149}Tb activity recoiling out of a gold target into the forward (F) and backward (B) directions was determined in irradiations with protons of 1, 3, 11.5, and 300 GeV. The values of F/B decreased from 9.6 at 1 GeV to 2.4 at 300 GeV. The values of $2W$ ($F+B$) decreased from 1.24 mg of Au per cm^2 at 1 GeV to 0.89 mg of Au per cm^2 at 300 GeV, where W is the thickness of the gold target. These results were analyzed in terms of the standard two-step model for the reaction. The momentum transfer, which occurs in the first step, decreases with the energy of the incident protons. The average kinetic energy of the ^{149}Tb nuclei in the second step is 3.9±0.1 MeV for protons in the energy range from 0.7 GeV (earlier work) to 300 GeV. The constancy of this value indicates that the reaction mechanism is essentially unchanged over this range of bombarding energies. (auth)

27712 ELECTRON-CAPTURE DECAY OF ^{206}Po. Jardine, L.J.; Shihab-Eldin, A.A. (University of California, Lawrence Berkeley Laboratory, Berkeley, California 94720). Phys. Rev. C 13: No. 1, 348-360 (Jan 1976).

The energies and intensities of 77 γ-ray transitions assigned to the electron-capture decay of ^{206}Po have been measured. Multipolarities of transitions were determined from internal conversion coefficients calculated from our relative γ-ray intensities and the relative conversion electron intensities of Fujika, Kanbe, and Hisatake. γ-ray singles, γ-γ coincidence, and previous conversion electron measurements were used to construct a more complete decay scheme for ^{206}Po. Data obtained from in-beam reaction studies, ^{210}At α decay studies and the present electron-capture decay scheme were used to identify states in ^{206}Bi of a one proton particle-three neutron hole character. In addition a qualitative discussion of the level structure of ^{206}Bi generated from (zero-order) couplings of $1h_{9/2}$ and $2f_{7/2}$ protons with the low-lying states of ^{205}Pb is given, and this is compared with reasonable success to the experimental spectrum. The dominant electron-capture decay rates are explained in terms of an allowed single-particle mechanism. (auth)

27713 L-SHELL INTERNAL IONIZATION IN THE BETA DECAY OF ^{203}Hg. Bond, A.; Gupta, O.P. (Brooklyn College of the City University of New York, Brooklyn, New York 11210). Phys. Rev. C 13: No. 1, 367-371 (Jan 1976).

L-shell internal ionization has been observed in the β decay of ^{203}Hg. A spectrum of Tl L x rays was obtained from a 0.12-μC source of ^{203}Hg in coincidence with 279-keV x rays from ^{203}Tl. The coincidence requirement served to eliminate internal-conversion x rays from the spectrum. The total L-shell internal ionization probability P_L obtained after normalization to the measured singles x-ray intensity, was found to be (12.9±0.5) × 10^{-4}. Estimates for the individual L-subshell internal ionization probabilities resulted in values of (0.0±6.5) ×10^{-4}, (4.8±2.3) ×10^{-4}, and (8.1±3.5) ×10^{-4} for P_{LI}, P_{LII}, and P_{LIII}, respectively. The measured value of P_L is over 4 standard deviations higher, and that of P_{LIII} over one standard deviation higher, than theoretical predictions. (auth)

27714 PHOTONEUTRON POLARIZATION STUDIES OF THE GIANT $M1$ RESONANCE IN ^{208}Pb. Holt, R.J.; Jackson, H.E. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 36: No. 5, 244-248 (2 Feb 1976).

The photoneutron polarization from states near threshold was measured, for the first time, for the reaction ^{208}Pb(γ,n_0)^{207}Pb throughout the neutron energy range 500 to 1000 keV. Spin and parity assignments were made for these states. The giant $M1$ resonance in ^{208}Pb was found to be less fragmented than previously thought. The data suggest that there is some "missing" $M1$ strength in ^{208}Pb. (auth)

27715 LEVEL STRUCTURE OF ^{192}Au AND ^{194}Au. Lakshminarayana, V.; Brock, R.; Huebel, H. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik). Z. Phys., A; 274: No. 3, 223-225(1975).

3 figs.; 2 tabs.; 7 refs.

The level structure of the odd-odd isotopes ^{192}Au and ^{194}Au was investigated by in-beam γ-ray spectroscopy with the reaction ^{nat}Ir(α, 3 nγ). Several new energy levels could be established in both isotopes. (DE)

27716 SOME FEATURES OF ODD Au NUCLEI REVEALED BY HALF-LIFE MEASUREMENTS. Berg, V.; Bourgeois, C.; Foucher, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de

Physique Nucleaire). J. Phys. (Paris); 36: No. 7, 613-616(Jul 1975).

The half-life (1.2 ± 0.1ns) of the 789.9 keV $9/2^-$ level in ^{193}Au is measured. The retardation of the de-exciting M1 and E2 transitions suggests that this $9/2^-$ state, as well as those found in 187, 189, 191 gold nuclei, issues from the $h_{9/2}$ orbit. The average shape of the Au nuclei in these states and of their even Pt cores is interpreted with the particle + asymmetric rotor model. (FR)

27717 ASYMMETRY OF BISMUTH FISSION BY α PARTICLES. Itkis, M. G.; Nemilov, Yu. A.; Nikolaev, V. A.; Okolovich, V. N.; Selitskii, Yu. A. Yad. Fiz.; 22: No. 4, 864-865(Oct 1975). (In Russian)

27718 DECAY OF ^{192}Tl AND ^{190}Tl. Vandlik, T. B.; Vandlik, J.; Zaitseva, N. G.; Mate, Z.; Mahunka, I.; Mahunka, M.; Tyrroff, H.; Fenes, T. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 5, 873-885(Nov 1975). (In Russian)

γ and conversion electron spectra of mass separated ^{192}Tl and ^{190}Tl samples were measured with the aid of Ge(Li) and Si(Li) detectors. In the case of ^{192}Tl 49 γ transitions were observed, from which 40 are new. Multipolarities of 22 transitions were determined. In the ^{190}Tl decay 21 γ transitions were observed, from which 13 are new. Multipolarities of 9 transitions were determined. A decay scheme of ^{190}Tl is proposed. Proceeding from the energy level systematics of even Tl isotopes and from the decay scheme of ^{190}Tl we assume that in the ^{190}Tl nucleus two isomeric states exist with similar half-lives: $(2^-)T_{1/2} = 3.4 \pm 0.3$ min and $(7^+)T_{1/2} = 3.4 \pm 0.2$ min. (4 tables, 3 figures) (auth)

27719 NUCLEAR DATA SHEETS FOR A equals 216. Ellis, Y. A. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 17: No. 3, 329-339(Mar 1976).

Nuclear structure information for all nuclei with mass number A equals 216 is summarized. Evaluated data and the adopted levels and spin and parity assignments are given. Only the alpha-decay mode has been observed for all nuclei in this mass chain. Possible epsilon-capture and/or beta-decay are expected to be quite weak for most of them. An upper limit of 0.6 percent was set by 68Val8 for ^{216}Th epsilon-decay from alpha-yields. The compilers estimate any epsilon-capture decay from ^{216}At to ^{216}Po to be less than 1.5×10^{-6} percent; similarly, beta-decay from ^{216}At to ^{216}Rn ground state is expected to be less than 0.0004 percent, and allowed β^- to any yet unobserved level in ^{216}Rn can be estimated to be less than 0.005 percent from expected log ft values. Level scheme information for all nuclei is from alpha-decays of their parents with A equals 220. alpha-parents are shown on the drawings above their daughters. alpha-decay data are given as much as possible on the drawings. For data with uncertainties and references, see A equals 220 compilation in this issue. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 27613, 27685, 27709, 27716, and 27779.

27720 (CEA-N-1821) MULTIGROUP FISSION AND CAPTURE CROSS SECTIONS OF Am-242m. Tellier, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). Sep. 1975. 26p. (In French). INIS.

For the physics of high burn up fuels and the plutonium recycle it is necessary to introduce the transplutonian nuclei in the reactor computation code. Because no evaluation of Am-242m is today available in the neutron data files, the fission and capture cross sections of this nucleus were estimated. For this purpose in the thermal range the experimental values of the resolved resonances parameters have been used in the fast range the average cross sections for the fission and a statistical model for the capture. This model is normalized on experimental fission data by adjustment of the transition levels scheme. It was not necessary to use a double humped fission barrier. Results are given in multigroup form for thermal reactors study. (FR)

27721 (FRNC-TH-585) COMPARATIVE STUDY OF FISSION BARRIERS AND THEIR EFFECTS UPON THE OTHER VARIABLES OF THE PHENOMENON. Alvim, C. F. (Grenoble-1 Univ., 38 (France)). 1975. vp. (In French). INIS.

An apparent coincidence exists between the experimental values of the fission barrier Ea and the mean neutron separation energy Sn. Since (Ea-Sn) was long considered as an important parameter to describe the behavior of fission, the experimental barrier values now available were used to find out whether the relationships proposed are still valid. The proposed dependence of fission and capture cross sections σ(f)/σ(c) on (Ea-Sn) was not found, which is not surprising since the initial hypotheses were rather crude. The dependence of σ(n)/σ(f) (the probabilities related to neutron emission and fission) on (Ea-Sn) seems not to exist for experimental values of Ea and Sn, although the γ(n)/γ(f) values considered appear to keep a simple dependence on Z^2/A. It was thus seen that the empirical expression used until recently to predict barriers from fission half-lives is not justified by the experimental values now available. Finally a possible correlation was found between the mean Sn values and the corrections to apply to the fission in order to smooth the log $T_{1/2}$ (spontaneous fission) curve versus Z^2/A. This correlation seems to be related to the coincidence between Ea and the mean value of Sn. (FR)

27722 (IAEA-169(Vol. 1), pp 3 v.; v. 1 p. 353-434) REVIEW OF FISSION PRODUCT YIELD DATA FOR FAST NEUTRON FISSION. Cuninghame, J. G. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The current position on fast fission yields, including cumulative and independent yields, the effect of change of neutron energy, 14 MeV yields, and ternary fission is summarized. Tables of data from recent yield evaluations are presented and compared, and new data not yet included in evaluations are given. Recommendations are made for measurements needed to fill the many large gaps in the data. (auth)

27723 (IAEA-169(Vol. 2), pp 3 v.; v. 2 p. 33-52) STATUS OF DELAYED NEUTRON DATA. Amiel, S. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Delayed neutron data are reviewed from the aspect of their use in reactor applications. Gross delayed neutron emission has been studied extensively in the past and available data appear to be sufficiently accurate. Problems encountered in measurement and evaluation of delayed neutron precursor data are discussed. Further work is required to obtain consistent sets of fission yields, delayed neutron yields and Pu values for individual precursors. Finally, recent high resolution results of delayed neutron energy spectra are presented. (auth)

27724 (IAEA-169(Vol. 2), pp 3 v.; v. 2 p. 163-200) PREDICTION OF UNMEASURED FISSION PRODUCT YIELDS. Musgrove, A. R. de L.; Cook, J. L.; Trimble, G. D. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data((FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

This paper summarized some methods of predicting unknown fission yields. Gaussian fitting methods are found to be a possible means of extrapolating fission yields for different neutron bombarding energies and for fissioning species for which measurements have not been made. Charge division and dispersion are also reviewed and the important enhancement effect for the direct yields of even Z nuclei is demonstrated. However, no universal charge division prescription for all fissioning nuclei is found. The yield enhancement for even Z nuclei is shown to be partly responsible for the fine structure in the mass yield curves. A new evaluation of prompt neutron reactions for ^{235}U is made for use in the calculation of charge division for this nucleus. (auth)

27725 (IAEA-169(Vol. 3), pp 3 v.; v. 3 p. 3-18) FISSION PRODUCT NUCLEAR DATA AND ENVIRONMENTAL ASPECTS OF THE NUCLEAR FUEL CYCLE. Laser, M.; Merz, E. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Among the nuclear data of fission products, important for their environmental aspects, the fission yield of tritium is known with only a relatively low degree of accuracy. This data should be redetermined exactly as a function of the neutron energy for ^{233}U, ^{235}U and ^{239}Pu fissions. In addition, other reactions for the formation of tritium should be included. Beyond this theme the activation product ^{14}C and the formation of actinide elements are of environmental importance. An exact knowledge of the cross sections may be helpful in environmental calculations. (auth)

27726 (IAEA-169(Vol. 3), pp 3 v.; v. 3 p. 137-142) ONE GROUP FISSION PRODUCT CAPTURE CROSS SECTIONS AS USED IN FAST REACTOR CALCULATIONS. Dean, C. J. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

In order to give a broad comparison of the various cross section evaluations available for use in fast reactor calculations a typical fast reactor spectrum has been used to form 1-group cross sections. This spectrum averaged over the 37 energy groups of the FD5 set is given in tabular form. One-group capture cross sections for fission products condensed from the 1971 Lucas Heights data and the Australian and Italian combined evaluation of 1967 over the energy range 10 MeV to 0.0001 eV using this standard fast reactor spectrum are given. (auth)

27727 (IAEA-169(Vol.3), pp 3 v.; v.3 p.215-242) INVESTIGATION OF THE GAUSSIAN WIDTH PARAMETER IN ^{235}U THERMAL NEUTRON FISSION. Zukeran, A. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973.).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The most stable charge Z_A has been obtained from the Garvey's mass table, and the most probable charge Z_p in $^{235}U(n_{th},f)$ has been estimated using the Z_A-values under the ECD postulate. Dependence of the estimated most probable charge Z_p on the mass number A has been compared with that of semi-empirical Z_P-values obtained from the observed fractional yields using the assumed Gaussian width parameter σ. The fairly well agreement between them has been confirmed. Contrarily to investigate on the Gaussian width parameter σ assumed above, the σ-value has been obtained from the same observed fractional yield using the estimated Z_P-value mentioned above. The resultant σ-values as functions of mass number A have been investigated from the point of view of dependencies on the neutron number n and proton number p respectively. It is found that some possible systematics may exist in the dependencies of σ-values on the n and p. To examine the validity of dependencies of Z_p and σ-values only on the mass number A, the following attempt has been made. If Z_p and σ-values depend only on the mass number A, there should be a common point (Z_p,σ) to all isotopes of the isobar on the Z_P-σ correlation curve, i.e., the calculated fractional yields based on the Gaussian distribution should be exactly equal to the observed ones of those isotopes. The result of investigation on the correlation between Z_p and σ shows that such a common point scarcely exists. It seems to be possible interpretation that Z_p and σ wouldn't be the functions of mass number A as a single variable but the functions of the proton and neutron numbers respectively. Further investigations, however, are still required, e.g., on the validity of simple Gaussian distribution function used for present work. (auth)

27728 (IAEA-169(Vol.3), pp 3 v.; v.3 p.245-279) YIELDS IN FAST NEUTRON FISSION OF U-238 AND Th-232. Lammer, M. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

A critical discussion of the status of yields in fast neutron fission of U-238 and Th-232 is presented. After a brief survey of relevant measurements of these yield data and a discussion of the dependence on the neutron energy spectrum the experimental data are critically compared and the uncertainties assessed. Existing evaluations are discussed. Recommendations are given for suitable measurement techniques and further measurements and evaluation work required. Th-232 fission yields are re-evaluated. (auth)

27729 (IAEA-169(Vol.3), pp 3 v.; v.3 p.281-322) COMPILATION OF FISSION PRODUCT YIELDS OF U-238 FOR 14 MeV NEUTRONS. Daroczy, S.; Raics, P.; Nagy, S. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Measured cumulative yields from the 14-15 MeV neutron induced fission of U-238 have been collected, corrected and recommended values are proposed also for masses without any published experimental data, by interpolation. The available independent and fractional cumulative yields are presented too. (auth)

27730 (IAEA-169(Vol.3), pp 3 v.; v.3 p.377-388) DELAYED NEUTRONS FROM FISSION: PRESENT STATUS OF MEASUREMENTS OF YIELDS, GROUP HALF-LIVES AND ABUNDANCES, AND SPECTRA. Evans, A. E. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The present status of measurements of delayed-neutron yields from fission, half-lives and relative abundances of delayed-neutron groups from fission, and spectra of delayed neutrons from fission is reviewed. Available data indicate that absolute delayed-neutron yields from fission of ^{233}U, ^{235}U, and ^{239}Pu are known to within ±7% while a 10% uncertainty exists in the delayed-neutron yield from fission of ^{232}Th, and a 17% discrepancy exists in the case of ^{238}U. The dependence of the delayed-neutron yield upon the energy of neutron-causing fission has been studied and is qualitatively understood. The question of incident-neutron energy dependence of relative delayed-neutron group abundances and half-lives is not well resolved. Recent measurements of delayed-neutron spectra indicate that these are of a complex, discrete energy nature. (auth)

27731 HOW TO DETECT THE HEAVIEST MAN-MADE ISOTOPES. Meldner, H.W. (University of California at San Diego, La Jolla, California 92037); Cowan, G.A.; Nix, J.R.; Stoughton, R.W. Phys. Rev. C 13: No. 1, 182-188 (Jan 1976).

The average number of neutrons emitted per spontaneous fission is predicted to increase substantially for very heavy nuclei. This suggests the use of neutron-multiplicity counters for the early detection of heavy isotopes produced by prompt neutron capture. We discuss the possibilities and limitations of such a technique. (auth)

27732 MASS AND KINETIC ENERGY MEASUREMENTS OF FRAGMENTS FROM THE ISOMERIC AND EXCITED STATE FISSION OF ^{242}Am. Weber, J.; Erdal, B.R.; Gavron, A.; Wilhelmy, J.B. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Phys. Rev. C 13: No. 1, 189-194 (Jan 1976).

Coincident fission fragment kinetic energies were measured for the isomeric and excited state fission of ^{242}Am. The fission isomer was produced using the $^{242}Pu(t, 3n)^{242}Am^m$ reaction, while the excited state fission was studied using the $^{241}Am(d, pf)$ direct reaction. The fission distributions were found to be very similar but significant deviations do occur. The isomeric average total kinetic energy is 2 MeV higher than the excited state fission ($4.4 \leq E_x \leq 11.5$ MeV) of ^{242}Am and the isomer has a lower yield for symmetric division. The mass distributions are qualitatively consistent with the isomer being more strongly influenced by the asymmetric outer fission barrier. (auth)

27733 PROMPT FISSION NEUTRONS FROM eV RESONANCES IN ^{235}U: MEASUREMENT AND CORRELATION WITH OTHER FISSION PROPERTIES. Howe, R.E.; Phillips, T.W. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550); Bowman, C.D. Phys. Rev. C 13: No. 1, 195-205 (Jan 1976).

The energy dependence of the fission neutron multiplicity $\bar{\nu}$ for neutron-induced fission of ^{235}U in the energy region 0.5 to 125 eV has been measured using a continuous spectrum of neutrons from a 100 MeV electron Linac. A new neutron detection technique was used to search for variations in resonance $\bar{\nu}$ values and possible correlations with other fission properties. Evidence was obtained for a nonstatistical fluctuation in the value of $\bar{\nu}$ as a function of energy. However, no correlation with resonant spin, Γ_f, fission-fragment asymmetry, or the angular distribution of fission fragments was observed. A comparison of these data with previous $\bar{\nu}$ measurements also has been included. (auth)

27734 TWOFOLD MASS SEPARATION METHOD IN THE SEARCH FOR SUPERHEAVY ELEMENTS IN NATURE. Epherre, M.; Klapisch, R. (Laboratoire René Bernas, B.P. No. 1, 91406 Orsay, France). Phys. Rev. C 13: No. 1, 206-208 (Jan 1976).

A recent search for superheavy elements in natural samples involves the observation of fission induced tracks from a mass separated sample. Using a high sensitivity mass spectrometer we propose a method to ascertain if the fission tracks observed in the mass region 280–310 originate in uranium molecular compounds. With a detection sensitivity of 10^7 atoms of ^{235}U we show that the fission tracks observed in a previously investigated Pt ore were associated with uranium molecules. (auth)

27735 SPONTANEOUS-FISSION HALF-LIVES FOR EVEN NUCLEI WITH $Z \geq 92$. Randrup, J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Larsson, S.E.; Möller, P.; Nilsson, S.G.; Pomorski, K.; Sobiczewski, A. Phys. Rev. C 13: No. 1, 229-239 (Jan 1976).

The spontaneous-fission process for doubly even nuclei with $Z \geq 92$ is studied in a semiempirical WKB framework. One-dimensional fission

barrier potentials are established from theoretical deformation-energy surfaces based on the droplet model and the modified-oscillator model. The effects of axial asymmetry as well as reflection asymmetry have been taken into account. Macroscopic (irrotational flow) inertial-mass functions and alternatively microscopic (cranking model) inertial mass parameters have been employed for the calculation of the fission half-lives. With one over-all normalization parameter it is possible to fit the experimental half-lives to within a factor of 20 on the average. The resulting effective inertial-mass functions are used to estimate the stability of the transactinide elements. Only minor differences with previous estimates for the *r* process and superheavy nuclei are encountered. (auth)

27736 NEW DETERMINATION OF THE HALF-LIFE OF ^{233}U. Vaninbroukx, R.; De Bièvre, P.; Le Duigou, Y.; Spernol, A.; van der Eijk, W.; Verdingh, V. (Central Bureau for Nuclear Measurements, 2440 Geel, Belgium). Phys. Rev. C 13: No. 1, 315-320 (Jan 1976).

Combining different methods, all based on the measurement of the specific activity of a large number of samples from two different batches of uranium oxides, both enriched to nearly 100% ^{233}U, a new determination of the half-life of ^{233}U was made. The activities of the samples were determined by α counting techniques: low geometry, liquid scintillation, and 4π-proportional counting. The uranium content of the samples was determined by mass spectrometric isotope dilution techniques and by controlled potential coulometry. The half-life was measured as $(1.5925+0.0040) \times 10^5$ yr. The uncertainty quoted is the over-all uncertainty at the 99.7% confidence level, taking into account both statistical and systematic effects. This result is in close agreement with the value published recently by Jaffey *et al.* and with the new recommended value, evaluated by Lemmel. (auth)

27737 COMMENT ON A DYNAMICALLY EXACT CLASSICAL DESCRIPTION OF COULOMB EXCITATION OF VERY HEAVY DEFORMED NUCLEI. Fröbrich, P.; Liu, Q.K.K.; Möhring, K. (Hahn-Meitner-Institut für Kernforschung Berlin GmbH, Bereich Kern- und Strahlenphysik, Berlin-West, Germany). Phys. Rev. C 13: No. 1, 430-433 (Jan 1976).

On assumption of an interaction model, a classically exact description is used to investigate the Coulomb excitation of rotational levels of very heavy deformed nuclei. We examine the suddenness of the excitation, the highest classically allowed spin to which the target can be excited, and the deviation from the Rutherford orbit of the projectile. Our calculations show that the perturbative method recently discussed by Rowley and Colombani is on the whole accurate. We do obtain a reduction of up to 4ħ of their values for classically allowed maximum spin excitable in the target. (auth)

27738 FISSION LIFETIME MEASURED BY BLOCKING EFFECT. Apostolescu, S.; Kemeny, P.; Macrin, R.; Petrascu, M.; Popescu, A.; Popescu, D. G.; Vertes, P. S. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 20: No. 8, 817-822(1975).

The fission lifetime of ^{238}Np in the reaction ^{238}U(p,nf) was measured by bombarding a UO_2 monocrystal with 9, 10, and 12 MeV protons and studying the blocking pattern of the fission fragments. (auth)

27739 PROBABILITY OF IONIZATION OF THE ATOMIC SHELL OF FISSIBLE ATOM INDUCED BY FLUCTUATIONAL ELECTROMAGNETIC FIELD OF THE HEATED NUCLEUS. Popeko, L. A.; Petrov, G. A.; Kochubey, E. F. (Leningrad Inst. of Nuclear Physics). Yad. Fiz.; 22: No. 3, 468-471(Sep 1975). (In Russian).

The yield of characteristic K radiation from uranium, accompanying the fission of ^{235}U for capture of thermal neutrons, is investigated. It is found that the yield does not exceed $3 \cdot 10^{-4}$ quanta per fission event; the fact does not contradict the theoretical estimate for the probability of the fluctuational ionization of electronic atomic shell in field of heated nucleus. (auth)

27740 COMPARISON OF THE SPECTRA OF PROMPT γ RADIATION FROM FISSION OF ^{233}U, ^{235}U, ^{238}Pu, AND ^{239}Pu INDUCED BY THERMAL NEUTRONS AND FROM SPONTANEOUS FISSION OF ^{252}Cf. Teterev, E. N.; Valskii, G. V.; Petrov, G. A.; Pleva, Yu. S. (Leningrad Inst. of Nuclear Physics). Yad. Fiz.; 22: No. 3, 462-467(Sep 1975). (In Russian).

The γ spectra produced in the thermal neutron fission of ^{233}U, ^{235}U, ^{238}Pu, ^{239}Pu and in the spontaneous fission of ^{252}Cf were measured and compared in the same experimental conditions. The fission fragments were recorded by a gas scintillation detector and the γ quanta were recorded by means of the NaJ(Tl) spectrometer. In the region from 0.5 to 3 MeV there were found considerable differences in the γ spectra being produced during 7 to 10 nsec after fission. The results are discussed in the framework of the available theoretical models on photon emission in fission. (auth)

27741 MEASUREMENT OF CROSS SECTION OF ^{249}Cf FISSION BY NEUTRONS WITH 0.25 TO 5.15 MeV ENERGY. Fomushkin, E. F.; Gutnikova, E. K.; Novoselov, G. F. Yad. Fiz.; 22: No. 3, 459-461(Sep 1975). (In Russian).

Dielectric track detectors are used to measure the cross section of ^{249}Cf fission induced by neutrons with the energy $0.25 \leq E_n \leq 5.15$ MeV. The statistical accuracy was 4 to 5%, the systematic error was 4.9%. The obtained results are compared with earlier published data. (auth)

27742 EXPERIMENTAL FISSION RESEARCH AT LUCAS HEIGHTS. Walsh, R. L. (Australian Atomic Energy Commission, Lucas Heights). At. Energy Aust.; 18: No. 2, 2-12(Apr 1975).

An account is given of fission research at the AAEC which includes: (1) measurement of the average number of prompt neutrons per fission event for ^{252}Cf; (2) studies of fission neutrons, fission fragment, kinetic energies and angular distribution which provide information on the properties of the compound nucleus as it proceeds from the saddle point through to scission and beyond. (AT)

27743 FRAGMENT ANGULAR DISTRIBUTIONS FROM FISSION OF ^{238}U, ^{209}Bi AND ^{197}Au BY 140-MeV ^{4}He IONS. Clark, R. G.; Meyer, W. G.; Minor, M. M.; Roche, C. T.; Viola, V. E. Jr. (Maryland Univ., College Park (USA). Dept. of Chemistry). Z. Phys., A; 274: No. 2, 131-137(1975).

4 figs.; 2 tabs.; 25 refs.

The fission fragment angular distributions from reactions of 140-MeV ^{4}He ions with ^{238}U, ^{209}Bi and ^{197}Au have been studied. From the anisotropies in the angular distributions, values for Jeff, the effective moment of inertia at the fission saddle point, have been estimated and compared with results obtained at lower bombarding energies. The derivation of Jeff values has included corrections for the effects of incomplete fusion mechanisms on the orbital angular momentum distribution of the fissioning nuclei and for neutron evaporation prior to fission. The results are also compared with heavy-ion-induced fission data for systems of similar fissility. Also, examination of the forward-backward symmetry of the ^{238}U angular distribution substantiates other results which show that the fraction of fission reactions which follow complete fusion of the target and projectile is less than 0.5 for 140-MeV ^{4}He ion bombardment of ^{238}U. (DE)

27744 THE INFLUENCE OF PAIRING AND NUCLEAR STRUCTURE ON THE THERMAL-NEUTRON-INDUCED FISSION OF ^{233}U. Clerc, H. G.; Lang, W.; Wohlfarth, H.; Schmidt, K. H.; Pferdekaemper, K. E.; Jungmann, R. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik); Schrader, H. (Institut Max von Laue – Paul Langevin, 38 – Grenoble (France)). Z. Phys., A; 274: No. 3, 203-213(1975).

10 figs.; 1 tab.; 28 refs.

The mass separated fission product beam provided by the mass separator "Lohengrin" has been used to determine the nuclear charge distribution for the thermal-neutron-induced fission of ^{233}U for all light fission products in the region $80 \leq A \leq 107$. The measurements were performed at the most probable kinetic energy of the fission products. By using the known fission product mass yields, the independent yields for a total number of 100 nuclides were obtained under the condition of the most probable kinetic energy. The proton pairing effect modulates the average nuclear charge of the fission fragments and the isobaric charge distribution widths in a regular fashion. The probabilities of breaking a pair and of forming fragments with an energetically unfavorable neutron-to-proton ratio are found to compete with each other. Both probabilities depend on the mass split and reach their maximum values in the region of the most probable masses. The odd-even-proton effect is found to vary smoothly between 16% for the most abundant mass splits and 40% for the rare mass splits. The odd-even-neutron effect exhibits maxima near N = 50 and N = 60, where it reaches 16%. These maxima and the extremely low Tc-yield (0.13%) are discussed with regard to fragment shell effects. (DE)

27745 NEGATIVE-PARITY STATES OF ^{238}U IN THE MODEL OF INTERACTING OCTUPOLE PHONONS COUPLED TO A DEFORMED CORE. Nomura, M. (CNR, Strasbourg). Lett. Nuovo Cim.; 15: No. 11, 383-386(13 Mar 1976).

Assuming that octupole phonons are coupled to a deformed core, the energy spectra and electromagnetic transition properties of $K = 0^-$, 1^-, and 2^- bands in uranium-238 are studied. It is concluded that the present model is very useful for an understanding of the negative-parity bands in uranium-238. The described model is really a schematic one which should be understood in terms of the microscopic Hamiltonian. But it is a good model for nuclei in which large magnitudes of B(E3) are observed. (JFP)

27746 PRODUCTION OF SPONTANEOUSLY FISSIBLE ISOMER STATE ^{242m}Am IN CAPTURE OF THERMAL NEUTRONS. Val'skii, G. V.; Varentsov, V. L.; Petrov, G. A.; Pleva, Yu. S.;

Aleksandrov, B. M.; Krivokhatskii, A. S. (Leningrad Inst. of Nuclear Physics). Yad. Fiz.; 22: No. 4, 701-702(Oct 1975). (In Russian).

With an external thermalized reactor neutron beam, the cross section σ_i is measured for production of the spontaneously fissible isomer state in the reaction $^{241}Am(n,\gamma)\ ^{242m}Am$. The results are: $\sigma_i/\sigma_f = (1.9 \pm 0.3)\cdot 10^{-4}$, $T_{\frac{1}{2}} = 10.2 \pm 0.9$ msec. 1 figure. (auth)

27747 ANGULAR ANISOTROPY OF FRAGMENTS FROM FISSION OF ^{235}U ORIENTED NUCLEI INDUCED BY 10 TO 150 keV NEUTRONS. Gonin, N. N.; Goryunov, V. K.; Kozlovskii, L. K.; Rabotnov, N. S.; Stavisskii, Yu. Ya.; Tambovtsev, D. I. Yad. Fiz.; 22: No. 4, 692-700(Oct 1975). (In Russian)

The results of measuring the angular anisotropy of fragments from fission of the ^{235}U oriented nuclei by thermal neutrons and by neutrons with the energy E_n = 10, 50, 80, 124 and 155 keV are presented. For the energies 50, 80, 124 and 155 keV we have measured the anisotropy on disoriented nuclei. The experimental results are compared with the data of other authors. The observed values of anisotropy are interpreted in the framework of present model approach to nuclear fission. 3 tables, 4 figures. (auth)

27748 ENERGY LEVELS OF ^{241}Pu NUCLEUS. Baranov, S. A.; Shatinskii, V. M. (Inst. of Atomic Energy, Moscow). Yad. Fiz.; 22: No. 4, 670-673(Oct 1975). (In Russian)

The magnetic α spectrometer is used to study the decay of ^{245}Cm. The curium source enriched with a mass number 245 isotope was used in the experiment. The α spectra of the isotope are given. The experimental data are analyzed and the energy level scheme of the ^{241}Pu nucleus is built. A ground state band of that nucleus with the first quantum numbers $5/2^+$ [622↑] and the energy levels $0(5/2^+)$, $41(7/2^+)$ and $94(9/2^+)$ keV is found. 2 figures, 1 table. (auth)

27749 DETERMINATION OF SPINS OF SPONTANEOUSLY FISSIONABLE ISOMERS. Fam Zui Khien. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 5, 938-946(Nov 1975). (In Russian)

On the basis of the previous analysis of the nuclear disorientation in emission of nucleons and γ quanta in nuclear reactions a simple model is proposed for calculating the spin orientation of spontaneously fissionable isomers, produced in reactions with α particles. This model is used to determine spins of spontaneously fissionable isomers from the data on the angular anisotropy of fission fragments. If there are two isomeric states in the second well, their spins are also determined from the data on the ratio of the cross sections (the isomeric ratio for the second well). 2 tables. (auth)

27750 CROSS SECTION OF ^{227}Ac FISSION BY NEUTRONS. Kuks, I. M.; Selitskii, Yu. A.; Funshtein, V. B.; Khlebnikov, S. V.; Shestakov, V. I.; Shestakova, I. A. Yad. Fiz.; 22: No. 5, 934-937(Nov 1975). (In Russian)

The cross section of ^{227}Ac fission by neutrons with their energy E_n = 0.9 to 18.6 MeV is measured. The effective fissionability W_f of the compound nucleus ^{228}Ac is calculated and the fission barrier $B_f = 7.1 \pm 0.2$ MeV is determined. The obtained values W_f agree with fissionabilities of that nucleus determined from the reaction $^{226}Ra(d,f)$ and essentially differ from the values of $W_f(^{228}Ac)$ from the reaction $^{226}Ra(^3He, pf)$. 2 figures. (auth)

27751 PAIR CORRELATION EFFECTS OF NUCLEONS IN (γ,f) REACTIONS IN ^{233}U AND ^{239}Pu. Ermagambetov, S. B.; Istekov, K. K.; Nurpeisov, B.; Puzeev, M. G. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 46-51(1974). (In Russian)

Detailed measurements were made of the angular distribution of fission fragments from the fission of ^{233}U and ^{239}Pu induced by α particles at 19 to 50.4 MeV. The measurements were made at the isochronous cyclotron of the Institute of Nuclear Physics of the Academy of Sciences, Kazakh SSR. From the experimental data in accordance with the theory of the angular distribution of fission fragments, the energy dependence of the parameter K_0^2 was obtained. The effect of pair correlation of nucleons of the superconducting type on the transition state spectra of the fissioning nuclei was shown. The critical energies of the phase transition $E_{tr}^+ = 12.0^{+1.0}_{-0.5}$ MeV and $14.5^{+1.0}_{-0.5}$ MeV and the values of the energy gap in the transition states $\Delta_0^+ = 0.86$ and 0.94 MeV were determined for ^{237}Pu and ^{243}Cm, respectively. (tr-auth)

27752 SYSTEMATICS OF FISSION ISOMER HALFLIVES. Metag, V. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nukleonika; 20: No. 7-8, 789-799(1975).

The most recent developments in fission isomer halflives are reviewed. New data in the sub-ns region have helped to clarify the systematics of fission isomer halflives. An empirical correlation is given which reproduces all observed halflives within a factor 3. The magic neutron number at the deformation of the 2nd minimum is found to be 146. There is no evidence for a magic proton number. Quantitative results on the odd-even effect of the halflives are discussed. (auth)

27753 GROUPING OF NEUTRON WIDTHS OF ^{232}Th p LEVELS. Vorotnikov, P. E. Sov. At. Energy (Engl. Transl.); 38: No. 4, 329-330(Apr 1975).

Translated from At. Energ.; 38: No. 4, 258-259(Apr 1975).

Reduced neutron widths for p resonances in ^{232}Th are shown in which relatively narrow groups of "strong" levels are located at $E_n \sim 150$, 500, 850, 1100 eV, etc. The distribution of magnitudes is apparently divided into two parts, but the ratios of the number of "weak" levels to the number of "strong" levels, as for fission levels of other heavy nuclei, does not obey the $2I + 1$ rule. It is shown that the distances D between "strong" levels do not follow the simple Wigner distribution. Apart from small D, corresponding to resonances belonging to a single group, one observes very large D associated with spaces between groups. The most simple and natural explanation of such structures is that they are due to excitations more simple than compound states. Such excitations manifest themselves in other nuclear reactions as input, analog, cluster, and similar states and cause a great local increase of partial widths. 3 figures. (auth)

27754 PARAMETERS OF THE NEUTRON RESONANCES OF ^{241}Am IN THE ENERGY RANGE FROM 8 TO 30 eV. Belanova, T. S.; Kolesov, A. G.; Nikolaev, V. M. Sov. At. Energy (Engl. Transl.); 38: No. 1, 33-37(Jan 1975).

Translated from At. Energ. (USSR); 38: No. 1, 29-34(Jan 1975).

Measurements of the energy dependence of the total neutron cross section of ^{241}Am were carried out using the time-of-flight method in the energy range 8 to 30 eV. Resonance parameters obtained are generally in agreement with results published elsewhere. (SDF)

27755 ANALYSIS OF ^{233}U RESONANCE ABSORPTION. Yoo, K. J. (Korea Atomic Energy Research Inst., Seoul); Cho, M.; Kim, C. H.; Chi, C. Y. J. Korean Nucl. Soc.; 7: No. 4, 267-275 (Dec 1975).

The low-lying resolved resonance structure of ^{233}U is investigated in terms of the Adler-Adler multilevel formalism. The resonance capture and fission cross sections of ^{233}U below 60 eV are calculated using Adlers' effective resonance parameters. The infinite dilution resonance integrals of ^{233}U are computed with the use of the Adlers' parameters adjusted to fit the cross section data. It is found that the agreement of calculations with experiments is generally good over most of the energy region covered. A transformation of the Adlers' multilevel parameters into an equivalent set of the single level pseudoparameters is made for the use of the existing computer codes which are useful in the reactor calculations but do not have capability to use the multilevel parameters. The results of this transformation are presented in the form of a table. 4 tables, 1 figure. (auth)

27756 ACTIVITY OF ^{99}Mo FROM THE SPONTANEOUS FISSION OF ^{238}U AND FROM OTHER NUCLEAR PROCESSES OCCURRING IN NATURAL URANIUM. Sherwood, J. D. Fayetteville, AR; Univ. of Arkansas (1975). 81p. University Microfilms Order No. 75-27,694.

Thesis (Ph. D.).

The spontaneous fission decay constant of uranium-238 was studied by measuring the equilibrium activity of molybdenum-99 in uranium systems. Other contributions to the activity of molybdenum-99 were studied and characterized. The equilibrium activity of molybdenum-99 was radiochemically determined in three different uranium systems. A method of calculating the probability of an (alpha,n) reaction occurring in a three dimensional system on a light element such as beryllium was devised. Calculations were performed to determine that 500 million years in the geological past was the latest date that a critical chain reaction could take place in nature. (Diss. Abstr. Int., B)

27757 NUCLEAR DATA SHEETS FOR A equals 220. Ellis, Y. A. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 17: No. 3, 341-350(Mar 1976).

Nuclear structure information for all nuclei with mass number A equals 220 is summarized. Evaluated data and the adopted levels and spin and parity assignments are given. Level scheme information for all nuclei is from alpha-decays of their parents with A equals 224. alpha-parents are shown on the drawings above their daughters. alpha-decay data are given as much as possible on the drawings. Unless otherwise indicated, gamma-transition (photon + ce) intensities are shown. For data with uncertainties and references, see A equals 224 compilation in this issue. (auth)

27758 NUCLEAR DATA SHEETS FOR A equals 224. Ellis, Y. A. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 17: No. 3, 351-366(Mar 1976).

Nuclear structure information for all nuclei with mass number A equals 224 is summarized. Evaluated data and the adopted levels and spin and parity assignments are given. Data for ^{224}Rn and ^{224}Fr beta-decays and ^{224}Fr decay schemes are from unpublished

work by V. P. Afanesev, et al. (1973), and should be considered preliminary. ^{224}Ac epsilon-decay data and decay scheme are from unpublished work by M. W. Hill (1958), who used NaI crystal to detect photons. A complete, more reliable decay work would be desirable, and would be useful to determine the ^{224}Ac ground-state spin. alpha-parents are shown on the drawings above their daughters. alpha-decay data are given as much as possible on the drawings. Unless otherwise indicated, gamma-transitions (photon + ce) intensities are shown. For data with uncertainties and references, see A equals 228 compilation in this issue. (auth)

27759 NUCLEAR DATA SHEETS FOR A equals 228. Horen, D. J. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 17: No. 3, 367-390(Mar 1976).

The experimental data for nuclei in the mass chain A equals 228 have been examined, and the results summarized. Where possible, the results are presented in pictorial form. The text contains tables of adopted levels and properties, tables of radiations, comments which point out deficiencies or inconsistencies in the data, and a reference list. For those cases where only tentative or partial decay schemes are given, the reader is encouraged to contact the compiler for more specific detail. Structure information is relatively sparse except for the ^{228}Th nucleus. Except where noted, Q-values have been adopted from 74WaBG. Data for the decay of the ground states of the A equals 232 isotopes have been taken from 70Sc37 since there has been little modification except for the half-life of ^{232}Pu (see 73Ja06) and alpha decay of ^{232}U (see 71So15) and 72Go33). Data on the alpha decay of A equals 228 nuclei have been taken from the compilation for A equals 224 (this issue) by Y. A. Ellis. In the drawings, transition intensities per 100 decays of the parent are given. The compilation has been prepared by computer from data sets entered by the compilers into the Evaluated Nuclear Structure Data File (ENSDF). Corrections or additions to the content of this compilation should be addressed to the compiler for inclusion in the ENSDF. (auth)

27760 NUCLEAR DATA SHEETS FOR (EVEN-A) A equals 244 THROUGH A equals 262. Schmorak, M. R. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 17: No. 3, 391-484(Mar 1976).

The available experimental data pertaining to the nuclear structure of nuclei with even mass numbers A equals 244 through 262 are compiled (the odd-A mass chains will be published in 1976). The results from various decay and reaction measurements, as available through September 1975, are compared and evaluated and alpha-hindrance factors are calculated. (auth)

27761 MEASUREMENT OF THE NEUTRON CAPTURE AND FISSION CROSS SECTIONS OF ^{239}Pu AND ^{235}U, 0.02 eV TO 200 keV, THE NEUTRON CAPTURE CROSS SECTIONS OF ^{197}Au, 10 TO 50 keV, AND NEUTRON FISSION CROSS SECTIONS OF ^{233}U, 5 TO 200 keV. Gwin, R.; Silver, E. G.; Ingle, R. W.; Weaver, H. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 59: No. 2, 79-105(Feb 1976).

The neutron absorption and fission cross sections for ^{239}Pu and ^{235}U have been measured over the neutron energy range from 0.02 eV to 200 keV. In addition, the neutron capture cross section for ^{197}Au was measured from 10 to 50 keV and the fission cross section of ^{233}U was measured from 0.1 to 100 keV. Normalization of the ^{239}Pu and ^{235}U data was made over the energy region from 0.02 to 0.4 eV to the ENDF/B-III neutron cross sections for these isotopes, Mat 1159 and 1157, respectively. The capture cross section for ^{197}Au was normalized using the saturated resonance method for the 4.9-eV resonance. For ^{233}U fission, the normalization was made using the results of Weston et al. The neutron flux was measured using the ^{10}B(n,alpha) reaction; the energy variation used for this reaction was that given in ENDF/B-III. The pulsed-neutron beam for these measurements was generated using the Oak Ridge Electron Linear Accelerator. A large liquid scintillator about 40 m from the neutron source was used to detect the prompt gamma-ray cascades resulting from neutron absorption in the sample. The time interval between the burst of neutrons and the detection of the absorption event was used to establish the neutron energy scale. The sample of the fissile isotopes was contained in multiplate (pulse) ionization chambers and those neutron absorption events detected in coincidence with a pulse from the ionization chamber were defined as fission events. In general for ^{239}Pu and ^{235}U, these experiments indicated lower neutron fission cross sections than contained in ENDF/B-III for energies above 10 keV. The measured values of the ratio alpha, neutron capture-to-neutron fission, for ^{239}Pu agree within errors with those derived from ENDF/B-III, Mat 1159. For the present measurements, the uncertainty on alpha for ^{239}Pu is approximately 11 percent at 10 keV and increases to approximately 30 percent at 100 keV. The experimental results for the neutron capture cross section for ^{197}Au are approximately 15 percent lower than the ENDF/B-III values. The measurements of the ratio of the neutron fission cross section for ^{233}U to that for ^{235}U are generally higher than the ENDF/B-III values by approximately 5 percent. 15 tables, 11 figures. (auth)

27762 UNCERTAINTY ANALYSIS OF FISSION-PRODUCT DECAY-HEAT SUMMATION METHODS. Schmittroth, F. (Westinghouse Hanford Co., Richland, WA). Nucl. Sci. Eng.; 59: No. 2, 117-139(Feb 1976).

The effect of uncertainties in the basic nuclear data needed in fission-product decay-heat summation calculations is considered. A variety of methods are developed to study the effect of errors in decay energies, half-lives, fission yields, and metastable states. Based on preliminary estimates of the uncertainties in the basic data, these methods show that decay heat for typical reactor exposures can be calculated with an accuracy of 7 percent or better for cooling times greater than 10 sec. Attention is directed toward thermal fission of ^{235}U, although the more general problem of other fissionable nuclides is considered. For cooling times less than 1000 sec, the major sources of error are due to uncertainties in the decay energies and fission-product charge distributions. All calculations are based on ENDF/B-IV cross sections. 17 figures. (auth)

Nuclear Theory

Refer also to abstracts 27525, 27545, 27561, 27587, 27702, and 27709.

27763 (BNL-50445) REPORT OF THE WORKSHOP ON GeV/NUCLEON COLLISIONS OF HEAVY IONS: HOW AND WHY, NOVEMBER 29–DECEMBER 1, 1974, BEAR MOUNTAIN, NEW YORK. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 91p. (CONF-741152-). Dep. NTIS $7.25.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

Abstracts for 13 papers appear separately in NSA and ERA. (SDF)

For abstracts of individual papers see: 26907–26909, 27571, and 27764–27772.

27764 (BNL-50445, pp 1-12) POSSIBLE NEW FORM OF MATTER AT HIGH DENSITY. Lee, T. D. (Columbia Univ., New York). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

As a preliminary to discussion of the possibility of new forms of matter at high density, questions relating to the vacuum and vacuum excitation are considered. A quasi-classical approach to the development of abnormal nuclear states is undertaken using a Fermi gas of nucleons of uniform density. Discontinuous transitions are considered in the sigma model (tree approximation) followed by brief consideration of higher order loop diagrams. Production and detection of abnormal nuclear states are discussed in the context of high energy heavy ion collisions. Remarks are made on motivation for such research. 8 figures. (SDF)

27765 (BNL-50445, pp 14-17) CURRENT KNOWLEDGE OF THE INTERACTIONS OF RELATIVISTIC HEAVY IONS. Heckman, H. H. (Univ. of California, Berkeley). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

Some experimental results that have given some key information on the interactions of relativistic heavy ions are reviewed. Topics are (1) the nucleus-nucleus interaction in nuclear track emulsions, (2) target fragmentation studies, (3) particle production in heavy-ion collisions, and (4) fragmentation of relativistic ^{12}C and ^{16}O nuclei. 1 table (auth)

27766 (BNL-50445, pp 18-33) PION CONDENSATES. Brown, G. E. (NORDITA, Copenhagen). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

A study is made of pion condensation based on the neutron matter analysis of Sawyer and Scalapino. The formalism is first discussed, followed by examination of short-range nucleon-nucleon correlations, the s wave pion-nucleon interaction, and nucleon

self-energies. The role of isobars in bringing the pion condensate down to low densities is detailed. 10 figures, 2 tables. (SDF)

27767 (BNL-50445, pp 34-35) COMMENTS ON CHARGED PION CONDENSATION IN DENSE MATTER. Baym, G. (Univ. of Illinois, Urbana). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

Comments are offered on the physics of the instability leading to pion condensation and the condensed state is briefly discussed. (SDF)

27768 (BNL-50445, pp 36-38) NUCLEAR MATTER CALCULATIONS OF FINITE AND INFINITE NUCLEAR SYSTEMS FROM RELATIVISTIC FIELD THEORY. Kerman, A. K. (Massachusetts Inst. of Tech., Cambridge). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

A new direction for the calculation of nuclear properties with current knowledge of finite nuclei is briefly discussed. Main emphasis is on developing a framework in which the meson field can be made self-consistent. Three types of worthwhile experiments are suggested. 1 figure. (SDF)

27769 (BNL-50445, pp 39-47) POSSIBILITY OF NUCLEAR SHOCK WAVES IN RELATIVISTIC HEAVY ION COLLISIONS. Hofmann, J.; Stoecker, H.; Scheid, W.; Greiner, W. (Univ., Frankfurt am Main). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

Using a hydrodynamic model, the possibility of compression of nuclear matter in colliding nuclei is considered. A model suggesting the formation of ($^3/_2$, $^3/_2$) resonances and higher nuclear states as a consequence of thermal excitation of nucleons during the collision process is extended to include higher mass resonances. Their effect on the compression is examined. 1 table, 4 figures (SDF)

27770 (BNL-50445, pp 48-49) SHOCK WAVES IN COLLIDING NUCLEI. Siemens, P. J. (The Niels Bohr Inst., Copenhagen). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

The circumstances under which matter at high densities can be produced in heavy-ion collisions is considered. It is argued that laboratory energies of a few hundred MeV per nucleon will be suitable: the matter velocity will exceed the speed of sound, while the nuclear matter has sufficient stopping power to generate a shock front. (auth)

27771 (BNL-50445, pp 52-58) ASTROPHYSICAL IMPLICATIONS OF PION CONDENSATION. Sawyer, R. F. (Univ. of California, Santa Barbara). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

Consequences for neutron star structure of forms of abnormal nuclear matter and pion condensation effects are studied using different equations of state for neutron star matter. Pressure as a function of energy density and mass-radius relations are plotted. 7 figures (SDF)

27772 (BNL-50445, pp 67-70) SEARCH FOR ULTRADENSE NUCLEI IN COLLISIONS OF GeV/NUCLEON Ar + Pb. Price, P. B. (Univ. of California, Berkeley). 1974.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In report of the workshop on GeV/nucleon collisions of heavy ions: how and why. (Brookhaven National Lab., Upton, N. Y. (USA)).

The task of creating abnormal nuclear states is divided into two phases. First, the Bevalac is used to determine the optimum conditions for attaching high-energy heavy projectiles to heavy target nuclei, using Lexan plastic track detectors to identify heavy recoils ejected along the beam direction. Second, some property of such high-Z products that would indicate whether some of them could be stable ultradense nuclei are measured. (auth)

27773 (CONF-751227-1) STATISTICAL THEORY OF NEUTRON NUCLEAR REACTIONS. Moldauer, P. A. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 24p. Dep. NTIS $3.50.

From IAEA consultants meeting on use of nuclear theory in neutron nuclear data evaluation trieste; Argonne, Illinois, United States of America (USA) (8 Dec 1975).

The statistical theory of average neutron nucleus reaction cross sections is reviewed with emphasis on the justification of the Hauser Feshbach formula and its modifications for situations including isolated compound nucleus resonances, overlapping and interfering resonances, the competition of compound and direct reactions, and continuous treatment of residual nuclear states. 3 figures. (auth)

27774 (IAEA-169(Vol.3), pp 3 v.; v.3 p.123-136) ON THE CALCULATION OF TOTAL RADIATIVE WIDTHS OF NEUTRON RESONANCES. Benzi, V.; Reffo, G.; Vaccari, M. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Three different formulae have been proposed to estimate Γ_γ at neutron binding energy, namely the Brink formula, the Weigmann-Rohr formula and the Musgrove formula. The three formulae are briefly described in this paper. Results of calculations of Γ_γ, using the three formulae, are compared for all fission products, for which experimental data are available. (auth)

27775 (UL-1207) THE GENERATOR COORDINATE METHOD AND ITS APPLICATION TO COLLECTIVE EXCITATION STATES IN ATOMIC NUCLEI. Gruemmer, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik; Bonn Univ. (F. R. Germany)). Jun 1975. 52p. (In German). INIS.

19 figs.; 16 tabs.; 78 refs.

Collective phenomena in atomic nuclei have been described in this work within the framework of the generator coordinate method. The manner of description is fully microscopical except for the application of phenomenological forces such as the pairing force and the pairing + quadrupole force. It presents no exceptional difficulties in coupling various collective degrees of freedom or in including projections such as particle number and angular momentum projection in the model. Most of the collective nuclear properties can be satisfactorily described even in comparison to other models. The fact that the "backbending" in the rotation bands of some rare earths, for example, cannot be sufficiently explained is probably to be traced back to a few neglections of important degrees of freedom (possibly single particle excitations). (DE)

27776 ISOSPIN MIXING IN NUCLEAR RESONANCE LEVELS. Warke, C.S. (Tata Institute of Fundamental Research, Bombay 400 005, India). Phys. Rev. C 13: No. 1, 9-13 (Jan 1976).

The problem of isospin mixing in nuclear resonance levels is studied using the framework of Feshbach's unified theory of reactions. The nuclear matrix elements occurring in the theory are expressed in terms of the measured quantities. These relations would be useful in interpreting the experimental data. The unitarity limit on the phase of the mixing amplitude is derived. (auth)

27777 SOME EFFECTS OF PARTICLE IDENTITY IN MANY-BODY SCATTERING USING THE METHOD OF CHANNEL COUPLING ARRAYS. Kouri, D.J. (Chemistry Department, University of Houston, Houston, Texas 77004); Levin, F.S. Phys. Rev. C 13: No. 1, 14-19 (Jan 1976).

Scattering events of the type $a + A \rightarrow A + a$, where A is composed of $(n-1)$ particles all identical to a, are studied within the framework of the channel coupling array approach to many-body scattering. The n coupled equations describing the scattering derived under the assumption that the n particles forming the scattering system are distinguishable, are shown to collapse to a single equation when particle identity is taken into account and a particular choice of a channel coupling array which includes the important special case of channel permuting arrays is made. For this latter choice, which guarantees connectedness, only the exchange Born potential explicitly enters the integral equation for the transition operator or the differential equation for the scattering function. The present derivation provides a justification of equations used previously in e^- + H calculations. (auth)

27778 LOCALIZATION IN HEAVY-ION ELASTIC, INELASTIC, AND TRANSFER REACTIONS. Moffa, P.J.; Dover, C.B.; Vary, J.P. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 13: No. 1, 147-155 (Jan 1976).

A quantitative technique for studying the localization of heavy-ion reactions in both coordinate (r) and angular momentum (L) space has been developed. A comparison of the degree of localization in elastic, inelastic, and one-particle transfer reactions is presented. For elastic scattering, the localization is studied as a function of the angular range of the data. A fully quantum mechanical relationship between L and r is demonstrated. (auth)

27779 MICROSCOPIC CALCULATION OF NUCLEAR DISSIPATION. Koonin, S.E. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Nix, J.R. Phys. Rev. C 13: No. 1, 209-228 (Jan 1976).

By use of a time-dependent wave function of the BCS form, we compute microscopically the energy dissipated for a system with a monopole pairing force moving under the influence of a time-dependent single-particle potential. Quasiparticle generation and coupling of the two-quasiparticle modes of the system are included automatically and provide contact with the Landau-Zener formula. The single-particle potential is related to nuclear shapes generated by viscous hydrodynamical calculations of a fissioning ^{236}U nucleus. We attempt to determine the energy dissipated between the saddle point and scission point by requiring that at the scission point the energy dissipated in the microscopic calculations equal that dissipated in the macroscopic hydrodynamical calculations. This procedure leads to 34 MeV of dissipated energy, which is almost twice the value of 18 MeV obtained from macroscopic hydrodynamical calculations that reproduce experimental fission-fragment kinetic energies. The corresponding value of the nuclear viscosity coefficient determined from the microscopic calculations is 0.04 TP, compared to 0.015 ± 0.005 TP obtained from the macroscopic hydrodynamical calculations. The viscosity coefficient determined from the microscopic calculations is even larger if the dissipated energies are compared at a finite scission neck radius. As a possible resolution of this discrepancy, we propose that level splittings arising from axially asymmetric and reflection-asymmetric deformations during the descent from the saddle point to scission reduce the energy dissipation and make the nuclei only moderately viscous. (auth)

27780 OPTICAL POTENTIALS DERIVED FROM MICROSCOPIC SEPARABLE INTERACTIONS INCLUDING BINDING AND RECOIL EFFECTS. Siciliano, E.R.; Walker, G.E. (Department of Physics, Indiana University, Bloomington, Indiana 47401). Phys. Rev. C 13: No. 1, 257-278 (Jan 1976).

We first consider a projectile scattering from a nucleon bound in a fixed potential. A separable Galilean invariant projectile-nucleon interaction is adopted. Without using the fixed scatterer approximation or using closure on the intermediate target nucleon states we obtain various forms for the projectile-bound nucleon t matrix. Effects due to intermediate target excitation and nucleon recoil are discussed. By making the further approximations of closure and fixed scatterers we make connection with the work of previous authors. By generalizing to projectile interaction with several bound nucleons and examining the appropriate multiple scattering series we identify the optical potential for projectile elastic scattering from the many-body system. Different optical potentials are obtained assuming different projectile-bound nucleon t matrices and we study the differences predicted by these dissimilar optical potentials for elastic scattering. In a model problem, we study pion-nucleus elastic scattering and compare the predictions obtained by adopting procedures used by (1) Landau, Phatak, and Tabakin and (2) Piepho-Walker to the predictions obtained in a less restrictive, but computationally difficult treatment. (auth)

27781 INVARIANT POTENTIAL FOR ELASTIC PION-NUCLEUS SCATTERING. Cammarata, J.B. (Department of Physics and Astronomy, Universi..y of Maryland, College Park, Maryland 20742); Banerjee, M.K. Phys. Rev. C 13: No. 1, 299-314 (Jan 1976).

From the Wick-Dyson expansion of the exact propagator of a pion in the presence of a nucleus, an invariant potential for crossing symmetric elastic pion-nucleus scattering is obtained in terms of a series of pion-nucleon diagrams. The Chew-Low theory is used to develop a model in which the most important class of diagrams is effectively summed. Included in this model is the exclusion principle restriction on the pion-bound nucleon interaction, the effects of the binding of nucleons, a kinematic transformation of energy from the lab to the πN center of mass frame, and the Fermi motion and recoil of the target nucleons. From a numerical study of the effects of these processes on the π-^{12}C total cross section, the relative importance of each is determined. Other processes contributing to the elastic scattering of pions not included in the present model are also discussed. (auth)

27782 PERTURBATIVE APPROXIMATIONS TO THE EFFECTIVE INTERACTION: COMPARISONS WITH EXACT RESULTS FOR LARGE MATRICES. Pittel, S. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081); Vincent, C.M.; Vergados, J.D. Phys. Rev. C 13: No. 1, 412-429 (Jan 1976).

The effective interaction appropriate to a $(2s\text{-}1d)^2$ model space is studied for the $J^\pi = 0^+$ states of ^{18}O. Perturbation theory and various Padé approximants are compared with exact results obtained by solving large shell-model problems that realistically include many 3p-1h and 4p-2h states. We analyze two cases that differ only in the choice of the $(2s\text{-}1d)$ single-particle energies. In one, there is a collective 4p-2h intruder state, as well as several intruders at negative values of the coupling parameter. The perturbation theory expansion for the effective interaction is found to diverge in this case. The other case has no intruders and the perturbation expansion seems to converge. In both cases, third-order perturbation theory is found to be more accurate than second order, and gives matrix elements correct to 200 keV. The intruder states do not seem to be responsible for the fact that third-order terms are often larger than second-order terms. The $[N+1, N]$ Padé approximants of low orders are less accurate than third-order perturbation theory. However, the operator-valued [1,2] Padé approximant is accurate to 130 keV, for reasons that are not yet understood. (auth)

27783 NUCLEAR VISCOSITY AND WIDTHS OF GIANT RESONANCES. Auerbach, N.; Yeverechyahu, A. (Department of Physics and Astronomy, Tel-Aviv University, Tel-Aviv, Israel). Ann. Phys. (N.Y.) 95: No. 1, 35-52 (Nov 1975).

We write down a set of coupled hydrodynamic equations of the Navier-Stokes type which describe the motion of two compressible, viscous nuclear fluids. The solutions of these equations give rise to giant resonances of both isoscalar and isovector type. The viscosity terms in the equations are responsible for the damping of these resonances. Within this framework we obtain expression for the width of the resonances as a function of the mass number A, and relations between the widths and the excitation energies for various multipolarities ($J=0^+, 1^-, 2^+, 3^-, 4^+$), and isospins ($T=0,1$). The A dependence of the calculated widths exhibit the experimental trends of the giant dipole and isoscalar quadrupole widths. Also, as a result of the calculation we obtain estimates of the values of viscosity coefficients in nuclei. (auth)

27784 LOW-ENERGY THEOREMS FOR NUCLEAR COMPTON AND RAMAN SCATTERING AND $0^+ \to 0^+$ TWO-PHOTON DECAYS IN NUCLEI. Friar, J.L. (Department of Physics, Brown University, Providence, Rhode Island 02912). Ann. Phys. (N.Y.) 95: No. 1, 170-201 (Nov 1975).

Low-energy theorems for elastic photon scattering (nuclear Compton scattering) from a nucleus of arbitrary spin are derived in the nonrelativistic approximation through terms quadratic in the photon frequency. The same derivation is made for the special case of $0^+ \to 0^+$ nuclear excitation by inelastic photon scattering (nuclear Raman scattering). Use is made of the general principle of gauge invariance, which bypasses the need to specify the form of the current operator explicitly. A general discussion of the contribution of mesonic exchanges is made and their effect is isolated. The center-of-mass correction to the nuclear diamagnetic susceptibility is calculated. The $0^+ \to 0^+$ two-photon decay amplitude is obtained from the nuclear Raman amplitude and the transition rate is calculated. (auth)

27785 ELECTROMAGNETIC EXCITATION. Theory of Coulomb Excitation with Heavy Ions. Alder, K.; Winther, A. Amsterdam; North-Holland Publishing Company (1975). 371p. $45.95.

An exhaustive description is presented of the nonrelativistic theory of excitations in heavy-ion nuclear collisions caused by the electromagnetic field. Tables and graphs are given for the analysis of experiments and the text is illustrated by pertinent experimental results. The presentation is based on semiclassical methods, which also apply to other atomic and nuclear processes. (auth)

27786 THEORY OF NONADIABATICAL EFFECTS IN TRANSITION PROBABILITIES FOR EVEN-EVEN DEFORMED NUCLEI. Stockmann, M.I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yad. Fiz.; 22: No. 3, 479-493(Sep 1975). (In Russian).

Interaction of rotation with other degrees of freedom in nuclei is investigated by means of the generalized density matrix method. The self-consistent field, collective Hamiltonian and probabilities of the E2 transitions are calculated for an arbitrary interaction. The results are compared with other approaches. Inconsistency of the phenomenological description, based on the band mixing, is shown. In the model with pairing and quadrupole interaction new formulas are obtained in an explicit form, numerical calculations and comparison with the experiment are fulfilled. (auth)

27787 NUCLEAR AND HYPERNUCLEAR MATTER IN ONE-BOSON EXCHANGE MODEL WITH SUBTRACTION. Filimonov, V.A. (Tomsk Polytechnic Inst., USSR). Yad. Fiz.; 22: No. 3, 494-502(Sep 1975). (In Russian).

The potential Born amplitudes in the Hartree-Fock approximation for the nuclear matter are identified with the relativistic one-boson exchange amplitudes. To compensate the repulsive contributions to the one-boson amplitudes some subtraction constants are introduced in a SU(6)-symmetrical way. By means of the presented model, one is able to describe the density and the binding energy

of the nuclear matter, absence of a bound state in neutron system, characteristics of interaction of the Λ hyperon with nuclear matter and the binding energies of double hypernuclei. The behavior of the three-component Λ-nucleon matter is investigated in framework of the present model. (auth)

27788 ACCURACY OF THE SEMICLASSICAL DESCRIPTION OF REACTIONS IN THE SUBCOULOMB ENERGY REGION. Traber, A.; Trautmann, D.; Alder, K. (Basel Univ. (Switzerland). Inst. fuer Theoretische Physik). Z. Phys., A; 274: No. 3, 215-222(1975).

10 figs.; 9 refs.

The accuracy of the semiclassical approximation for Coulomb matrix elements is discussed. The absolute values of the matrix elements are in general well approximated, but the agreement of the semiclassical phases with the exact ones is less satisfactory. Therefore, we present a modified semiclassical approximation which essentially improves the values of the phases. This modified semiclassical approximation is obtained by the introduction of complex saddle point integration method. Since both the absolute values and the phases of the matrix elements are well reproduced by the modified semiclassical approximation, quantities depending on the phase can now also be calculated in the semiclassical manner. (DE)

27789 QUANTUM-STATISTICAL APPROACH TO GROSS PROPERITES OF PERIPHERAL COLLISIONS BETWEEN HEAVY NUCLEI. Noerenberg, W. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik; Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Z. Phys., A; 274: No. 3, 241-250(1975).

5 figs.; 25 refs.

Non-equilibrium quantum-statistical mechanics is applied to peripheral collisions between heavy nuclei ($A \gtrsim 40$) where a large number of degrees of freedom are involved during the process. By eliminating the relative motion from the explicit consideration, the transitions between different channels are determined by a Liouville equation with time-dependent coupling matrix elements. The introduction of subsets of channels (coarse graining) leads to the definition of macroscopic variables which correspond to observable quantities. The equation of motion for the macroscopic variables becomes irreversible by assuming the values of the coupling matrix elements to be randomly distributed. The validity and possible applications of the resulting master equations are discussed. (DE)

27790 EIKONAL EXPANSION IN ELECTRON SCATTERING. Pt. 1. Elastic Scattering. Rosenfelder, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Z. Phys., A; 274: No. 3, 267-273(1975).

6 figs.; 1 tab.; 20 refs.

A systematic eikonal expansion for the scattering of high-energy electrons from nuclei is derived which starts from the iterated Dirac equation. The resulting scattering amplitude is written in an impact parameter representation depending on eikonal phases which are proportional to inverse powers of the energy. The first two correction terms to the leading Glauber-Baker amplitude are calculated. For a Coulomb potential they agree with a sin $\theta/2$-expansion of the relativistic Coulomb scattering amplitude. In the case of scattering from an extended charge distribution at sufficiently high energies numerical partial wave calculations are accurately reproduced. (DE)

27791 THEORY OF OPTICAL POTENTIAL OF INELASTIC SCATTERING OF COMPLEX PARTICLES. Vovenko, V. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 21: No. 1, 67-72(Jan 1976). (In Russian).

Optic potentials are determined for describing inelastic scattering of complex particles by nuclei within a high energy region. It is shown that the role of effects of wave distortion of an incident complex particle sharply increases when the number of nucleons in it rises. (auth)

27792 THEORY OF THE ESR MEASUREMENT OF FIRST-ORDER NUCLEAR QUADRUPOLE MOMENT. Lue, J. T. (National Tsing Hua Univ., Hsinchu, Taiwan). Nuovo Cim., 31B: No. 2, 272-278(11 Feb 1976).

The nuclear quantization directions of a free radical depend strongly on the azimuthal quantum number of the electron spin. The unequally spaced hyperfine lines due to the first-order effect of the nuclear quadrupole interaction with nuclear spin $I = 1$ which occurs frequently in a nitrogen nucleus of a biomolecular crystal can be interpreted by using irreducible group transformations to transform the nuclear quantization axes into the laboratory frames without expanding the tensors in any arbitrary coordinate system. (auth)

27793 THRESHOLD OF PION CONDENSATION. Bertsch, G. (Michigan State Univ., East Lansing); Johnson, M. B. Phys. Rev., D; 12: No. 8, 2230-2236(15 Oct 1975).

The threshold density for pion condensation in neutron matter is determined with a model including nuclear interactions and the DELTA resonance in pi-nucleon scattering. Depending on the magnitude of N-DELTA correlations, pion condensation can have a threshold as low as 0.1 neutrons/fm^3 or not occur at all. Applying the model to nuclear matter, it was found that in the absence of N-DELTA correlations physical pions have a very large effective mass. With N-DELTA correlations, these effects are diminished, but pion condensation could still occur at twice normal nuclear matter density. (auth)

27794 REMARKS UPON A CERTAIN RELATION BETWEEN TWO VARIATIONAL BOSON EXPANSION METHODS. Raduta, A. A. (Univ., Frankfurt am Main); Ceausescu, V. Lett. Nuovo Cim.; 15: No. 4, 107-111(24 Jan 1976).

It is well known that the boson expansions of Belyaev-Zelevinsky performed with respect to the random phase approximation phonon are slowly convergent in the region of transitional (spherical deformed) nuclei. The connection between a previously proposed variational boson expansion method and one called the canonical transformation method. A many-body Hamiltonian containing a shell model term, the pairing interaction as well as the quadrupole - quadrupole interaction is considered. It is noted that within certain restrictions the two methods are identical, but the manners in which the two methods fix certain parameters are different. The canonical transformation method has the advantage of causing the dangerous graphs to vanish. (JFP)

27795 THERMODYNAMICAL PROPERTIES OF SPHERICAL NUCLEI. Kamchatnov, A. M. (Inst. of Atomic Energy, Moscow). Yad. Fiz.; 22: No. 5, 947-956(Nov 1975). (In Russian).

The effect of residual interaction between nucleons (between quasiparticles) on the thermodynamical behavior of spherical nuclei is considered. Thermodynamical relations are found for the simplest model of the residual interaction having the necessary macroscopic structure. The application region of the theory is discussed. 3 figures. (auth)

27796 MECHANISM OF INCOMPLETE FISSION REACTIONS WITH HEAVY IONS. Aleshin, V. P. (Inst. of Nuclear Research, Kharkov). Yad. Fiz.; 22: No. 5, 997-1002(Nov 1975). (In Russian)

A two-parameter formula reasonably reproducing the experimental angular distribution is obtained assuming that the dominating contribution to the cross section of the deep inelastic transfer reaction is from the angular momenta near to the critical value. 2 figures. (auth)

27797 LECTURES ON THE THEORY OF THE NUCLEUS. Sitenko, A. G.; Tartakovskii, V. K. Oxford; Pergamon Press (1975). 316p.

The lecture course consists of five chapters, entitled: nuclear forces; nuclear matter; shell structure of nuclei; rotation and vibrations of nuclei; and pair correlations in nuclei. It is stated that although most attention is given to the basic principles, some of the more recent achievements in nuclear theory are described. Different models of the nucleus are examined in detail and the interrelations between them are discussed. A number of the problems discussed have appeared only in original papers and have not been described in textbooks before. The lectures are intended as a student textbook. (UK)

27798 SEMI-CLASSICAL THEORY OF NUCLEAR SHELL STRUCTURE. Strutinsky, V. M. (Inst. for Nuclear Research, Kiev). Nukleonika; 20: No. 7-8, 679-716(1975).

A stationary phase method for the Feynman's path-integral representation is explained and extended to the important case of an arbitrary spherical single-particle potential. Results are illustrated by examples of the infinite spherical potential well considered previously by Balian and Bloch, who used a different method and the deformed harmonic oscillator. Formal estimates are obtained for shell effects in the nuclear level density and in the nuclear binding energies (the shell energy corrections). Relationship to the numerical averaging is discussed. Factors essential for the appearance of pronounced shell structure in nuclei are considered. (auth)

27799 EXOTIC NUCLEI WITH Z > N. Benenson, W. (Michigan State Univ., East Lansing). Nukleonika; 20: No. 7-8, 775-788 (1975).

The use of multinucleon transfer reactions to measure the mass and energy levels of nuclei far from β-stability is discussed. The results are compared to the predictions of the isobaric multiplet mass equation, Garvey-Kelson mass formulas and shell model calculations. (auth)

27800 SHAPE OF THE FISSION BARRIER. Specht, H. J. (Univ., Heidelberg). Nukleonika; 20: No. 7-8, 717-753(1975).

The experimental evidence supporting the double humped character of the fission barrier in actinide nuclei is reviewed and compared to theoretical predictions. The discussion covers the properties of spontaneously fissioning isomers, intermediate structure in fission cross sections, the systematics of fission barrier heights, and the implications of a possible octupole deformation at the second barrier for fragment mass distributions. (auth)

27801 FOUR LECTURES ON FISSION. Fragments of a Dynamic Theory of Collective Motion in Nuclei. Pauli, H. C. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nukleonika; 20: No. 7-8, 601-678(1975).

An accumulative, however, not complete presentation is given of the phenomenological, collective model with a special emphasis on fission. The various phenomenological approaches are discussed and some of them are presented in detail together with a comparison to experimental data. The dynamical aspects are stressed and reviewed. A natural definition of shape degrees of freedom in terms of density moments is suggested, without using them in detail. Collective variables are interpreted as being "time-like" and not "space-like", as implied by the generator coordinate method. In the framework of time-dependent Hartree-Fock theory, a collective and a potential energy are unambiguously defined. The formalism is preliminary and unmatured, but links to classical principles do not seem unlikely. (auth)

27802 ROLE OF POTENTIAL AND FRICTION IN THE DYNAMICS OF HEAVY ION REACTIONS. Sperber, D. (Rensselaer Polytechnic Inst., Troy, NY). Nukleonika; 20: No. 7-8, 755-774 (1975).

A classical theory with dissipative forces is used to analyze the reactions between heavy ions high above the Coulomb barrier. The importance of the interplay between the conservative nuclear potential and dissipative forces is discussed. It is demonstrated that a dynamical theory with dissipative forces is very useful for the interpretation of the experimental results. (auth)

27803 GENERAL EXPRESSION FOR THE TRACE OF THE PRODUCT OF AN ARBITRARY NUMBER OF COMPONENTS OF ANGULAR MOMENTUM. Indian J. Pure Appl. Phys.; 13: No. 11, 792-793(Nov 1975).

A general expression was derived for the product of an arbitrary number of components of the angular momentum vector, usually encountered in nuclear and atomic scattering problems. (auth)

27804 ASYMMETRIC ROTOR MODEL WITH ANGULAR-MOMENTUM DEPENDENT MOMENTS OF INERTIA. Samanta, B. C.; Banerjee, P. K. (Burdwan Univ., India). Indian J. Phys.; 49: No. 3, 198-202(Mar 1975).

The rotational energies of the different positive parity states of even-even nuclei were calculated on the basis of the Davydov and Filippov asymmetric rotor model using Sood's formula for the increase of moments of inertia with angular momentum. The results were compared with experiment and other works. (auth)

27805 FORBIDDEN TRANSITIONS DURING ANISOTROPHIC, ELECTRON-NUCLEAR INTERACTION. Alekseev, B. F.; Mamykin, A. I. (Leningrad Electrotechnical Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 38-43(1975). (In Russian)

On the basis of a method of perturbations a look is taken at the forbidden transitions in electron-nucleon systems with an arbitrary form for the tensor of the spin-spin interaction. (SJR)

27806 KNOCK-OUT PROCESSES AND REMOVAL ENERGIES. Dieperink, A. E. L.; de Forest, T. Jr. (Inst. for Nuclear Physics Research, Amsterdam). Annu. Rev. Nucl. Sci.; 25: 1-26(1975).

A derivation is given of the cross section for knock-out reactions, treating (e, e'N) as an example. Since the basic nuclear structure information is contained in the spectral function; a brief treatment is given of the specral function in the independent particle model. The question of how one can relate the energy dependence of the spectral function to the results of microscopic nuclear structure theories is considered in terms of occupation probabilities and mean removal energies. Higher moments of the spectral function characterizing such processes as fragmentation are discussed. 6 figures, 1 table, 51 references. (SDF)

27807 PREEQUILIBRIUM DECAY. Blann, M. (Univ. of Rochester, NY). Annu. Rev. Nucl. Sci.; 25: 123-166(1975).

After a description of the properties of particle spectra attributable to preequilibrium (PE) decay, a discussion is presented of models which have been applied in support of these characteristics as due to decay of states during the equilibration process. Specific models included are the cascade model, the Harp-Miller-Berne model, the exciton model, the hybrid and geometry-dependent hybrid models, and phase space approaches to PE decay. A brief summary of areas of application of PE is given along with speculation as to probable future directions. 22 figures, 2 tables, 107 references. (SDF)

27808 ELECTRON SCATTERING AND NUCLEAR STRUCTURE. Donnelly, T. W.; Walecka, J. D. (Stanford Univ., CA). Annu. Rev. Nucl. Sci.; 25: 329-405(1975).

Electron scattering is treated within the framework of the one-photon exchange approximation. Electron excitation of collective particle-hole states (including the giant dipole resonance) is detailed. The process of quasi-elastic scattering is then discussed within the framework of the Fermi gas model. A brief review is presented of the relationship between electromagnetic interactions and semileptonic weak interactions, stressing the extra knowledge that the electron scattering yields. Finally, a few special topics of interest in intermediate energy physics are examined. 221 references. (SDF)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 26039, 26226, 26230, 26304, 27214, 27219, and 27813.

27809 (GSF-K-75, pp v) PHYSICAL IRRADIATION PLANNING. Leetz, H. K. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

Following a definition of the physical irradiation plan, the methodics of the procedure are explained. Starting with the simplest case, irradiation where only the depth of the focus is known, the depth dose curves for single fields are calculated and extended to the overlapping of several single fields on the basis of a body cross-section. In addition to this calculation-graphical irradiation planning, the possibility of experimental determination of a dose distribution on the phantom is indicated. In addition, the possibilities resulting from the use of modern computers are shown in the individual calculation of dose distributions. (DE)

27810 (GSF-K-75, pp v) IRRADIATION PLANNING-OPTIMIZATION METHODS. Rosenow, U. May 1973. (In German).

In radiation protection in accelerators in medical use. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz).

A survey is given on the problems of the optimization of the spatial physical dose distribution in irradiation planning. It is thus made clear that the plurality of parameters even when using computers from the start leads to greatly limited conditions. By means of a few examples, the procedure of the calculation and automatic assessment using evaluation functions is shown. By comparing the concepts of the radiologists and the optimum plans suggested by the computer, assessment criteria can be chosen and irradiation plans quantified. (DE)

27811 (HEDL-TME-75-62) FAST FUELS RADIATION EXPOSURE MEASUREMENTS SEMI-ANNUAL PROGRESS REPORT, JULY-DECEMBER 1974. Smith, R. C.; Strode, J. N.; Brackenbush, L. W.; Faust, L. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1974. Contract E(45-1)-2170. 27p. AT.

This is the first semiannual progress report on the Fast Fuels Radiation Exposure Measurements program being conducted at the Hanford Engineering Development Laboratory (HEDL) for the Division of Reactor Research and Development (RRD). Data on occupational exposure and measurements of the radiations from fast-reactor mixed (UO_2-PuO_2) fuels are presented. Dose rate measurement data include; (a) gamma surface dose rates from mixed oxides as a function of the uranium dioxide dilution of plutonium dioxide, (b) neutron dose rates as a function of plutonium in mixed oxides, (c) dose rates from medium-exposure Pu (12 wt percent ^{240}Pu) and high-exposure Pu (19 wt percent ^{240}Pu) used in fuel fabrication through shielded and unshielded gloveboxes, and lead-loaded versus neoprene gloves, and (d) measurements of the neutron dose rates from 120 FFTF fuel pins. (auth)

27812 (HMI-B-180) A PROGRAMME TO CALCULATE THE ACTIVATION AND THE γ-DOSE RATE OF SAMPLES IRRADIATED IN A REACTOR. Criee, K.; Mottau, H.; Smit, J. G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kernchemie und Reaktor). Sep 1975. 57p. (In German). INIS.

The modular Fortran IV program "PROAKT" was written for the irradiation service in the reactor BER II. It is to calculate the activations of irradiated materials and their dose rates. The following data must thus be given to the keyboard of a terminal: irradiation time, decay period, thermal neutron flux, nuclear charge number and weight. The program which can be processed on a PDP 11/40 (16 K core storage) under the disk operating system, version V08/02, has an overlay structure due to its large scope. It contains 9 subprograms besides the main program which are summarized in a library, and 92 overlays in which the nuclide data are stored. On the assumption that all overlays contain nuclide data, storage space for 0.5 million 16 bit words is necessary for the loadable program. The program has been drawn up in the "conversational mode" so that the calculated values are immediately available to the user. (DE)

27813 (JUL-1219) ABSORPTION OF β-RADIATION UNDER VARIOUS TEST CONDITIONS. Heinzelmann, M. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Strahlenschutz). Jul 1975. 24p. (In German). INIS.

The absorption of the β-radiation is measured in tissue equivalent material for various test arrangements, and the results are compared with those in the literature. It is shown that the shape of the absorption curve is greatly changed by covering the preparate. A qualitative explanation for the differing absorption of the β-radiation with various test arrangements could be given by means of the measured average incident angle of the β-radiation. The influence of the preparate covering and of the test arrangement in the calibration of dosimeters is indicated. (DE)

27814 (PTB-ND-8) DOSIMETRY OF FAST NEUTRONS. Jahr, R. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany). Neutronendosimetrie). Mar 1975. 40p. (In German). INIS.

Following an explanation of the physical fundamentals of neutron dosimetry, the special needs in medicine and biology are discussed. It is shown that the dose equivalent used in radiation protection oversimplifies the complicated dependence of the biological effects. The reason for this is that the RBE for heavy recoil nuclei, amongst others, depends on the energy and sort of particle, whereas it is approximately equal to one for electrons independent of their energy. It is thus necessary in the fields of biology and medicine to have additional information on the energy spectra of the neutrons as well as of all charged secondary particles as a function of the position in the phantom. These are obtained partly by calculation and partly by special dosemeters. The accuracy achieved so far is 5%. (DE)

27815 (RD/B/N-3178) USER'S MANUAL FOR THE THREE-DIMENSIONAL MONTE CARLO TRANSPORT CODE SPARTAN. (SPARTAN Development Report 3). Bending, R. C.; Heffer, P. J. H. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1975. 67p. (FREDSWG/P-(75)9; RPC/Sh/P-(75)11; FRCMWG/P-(75)163). Dep. NTIS (US Sales Only) $4.50.

SPARTAN is a general-purpose Monte Carlo particle transport code intended for neutron or gamma transport problems in reactor physics, health physics, shielding, and safety studies. The code uses a very general geometry system enabling a complex layout to be described and allows the user to obtain physics data from a number of different types of source library. Special tracking and scoring techniques are used to improve the quality of the results obtained. To enable users to run SPARTAN, brief descriptions of the facilities available in the code are given, and full details of data input and job control language, as well as examples of complete calculations, are included. It is anticipated that changes may be made to SPARTAN from time to time, particularly in those parts of the code which deal with physics data processing. The load module is identified by a version number and implementation date, and updates of sections of this manual will be issued when significant changes are made to the code. (auth)

27816 COMPUTER GENERATION OF HIGH-ENERGY X-RAY DOSE DISTRIBUTIONS. Schulz, R.J.; McKiernan, F.; Agostinelli, A.G. (Department of Therapeutic Radiology, Yale University School of Medicine, New Haven, Connecticut 06510). Med. Phys. 3: No. 1, 12-18 (Jan 1976).

A computer program for the generation of high-energy x-ray dose distributions has been developed. The program takes account of the fact that the x-ray beam profile, as affected by penumbra, wedges, beam blocks, or flattening filters, is one of the prime determinants of the dose distribution. Doses from primary and scattered radiation are calculated separately by using published tissue-air ratio (TAR) and scatter-air ratio (SAR) data. The dose from scattered radiation is determined by dividing the x-ray field into a series of scatter strips and summing the contribution from each. Wedges or beam blocks are taken into account simply by entering their actual coordinates and linear attenuation coefficients. The program may be used to design wedges, beam blocks, or flattening filters prior to fabrication. Complete libraries of dose distributions for ^{60}Co, 2-, 4-, and 6-MV x rays have been generated. (auth)

27817 FAST-NEUTRON DOSE RATE VS ENERGY FOR THE d+Be REACTION—A REANALYSIS. Smathers, J.B.; Otte, V.A. (Nuclear Engineering Department, Texas A&M University, College Station, Texas 77843); Smith, A.R.; Almond, P.R. Med. Phys. 3: No. 1, 45-47 (Jan 1976).

The differences in the published information concerning tissue kerma

in air vs deuteron energy for the $d+Be$ reaction are analyzed in light of some recent measurements. The reason for the discrepancy is determined to be a lack of electron suppression on the Be target in some earlier measurements, and the relation $\ln(\text{tissue kerma}) = \ln(1.356\times10^{-4})+2.97\ln E$ is found to fit the measured data over the deuteron energy range 11–50 MeV. (auth)

27818 VOPROSY MIKRODOZIMETRII. (Problems in Microdosimetry. Proceedings of the All-Union Conference Held June 12-15, 1973, in Moscow, USSR). Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). 96p. (CONF-7306124-).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973).

The 27 articles presented at the Conference are compiled. Processes of the energy transfer of ionizing radiation in microstructures of very different nature and dimensions, from atomic and molecular systems up to living cells, are examined. Experimental techniques and microdosimetry and its computational methods are discussed. Individual abstracts were prepared for all the papers. (tr-auth)

For abstracts of individual papers see: 25464, 26061, 26128, 26140–26146, 26156, 26305, 26308, 27214, and 27819–27831.

27819 MICRODOSIMETRY IN RADIOBIOLOGICAL EXPERIMENTS AND THEORY. Barsukov, V. S. pp 7-11 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

A general discussion is given of the relation of quantitative radiobiology and microdosimetry. It is shown that microdosimetry is not a separate part of radiobiology in general and cellular radiobiology in particular. Microdosimetric measurements in volumes equivalent to cell nuclei give the characteristics of radiation necessary for the profound analysis of experimental data on the cellular and subcellular levels. The microdosimetric approach makes it possible to stimulate radiobiological reactions at these levels. (JSR)

27820 SPHERICAL TISSUE-EQUIVALENT PROPORTIONAL COUNTER IN A NEUTRON RADIATION FIELD. Belonogii, P. N.; Ivanov, V. I.; Solov'ev, V. A.; Kharlamov, A. D. pp 14-17 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

A spherical tissue-equivalent proportional counter of the Rossi type was constructed for the measurement of the microdistribution of the absorbed energy from a monoenergetic neutron source. The calibration spectrum obtained with a ^{239}Pu α source is given. The distribution of the absorbed energy according to the dimensions of the event was determined for equivalent diameters of 1, 5, and 10 μm during irradiation with 14.2-MeV neutrons. The dose distributions obtained with the present counter are compared with those obtained by Rossi at different neutron energies. (JSR)

27821 MICRODISTRIBUTION OF ABSORBED ENERGY IN TISSUE-EQUIVALENT SENSITIVE VOLUMES WITH LINEAR DIMENSIONS OF THE ORDER OF 1 μm. Belonogii, P. N.; Ivanov, V. I.; Makshakov, B. V. pp 20-23 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stov Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

On the basis of previously proposed methods for the calculation of microdosimetric magnitudes, theoretical calculations were made of the microdistribution of absorbed energy. The results obtained for α particles of ^{239}Pu and ^{238}Pu and for ^{60}Co γ radiation were compared with experimental results with very good agreement. (JSR)

27822 APPARATUS FOR THE MEASUREMENT OF MICRODOSIMETRIC VALUES AND DISTRIBUTION IN A FAST NEUTRON FIELD. Bregadze, Yu. I.; Marchenko, A. V.; Maslyaev, P. F.; Sidorenko, L. M. pp 23-25 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

Structural diagrams are given for two microdosimetric installations with automatic readout of the results and deduction of time limitations that previous installations had. The first is an installation for the measurement of the distribution of the number of events with respect to specific energy at a given value of the absorbed dose and the second is for the measurement of the distribution of the number of n-events with respect to specific energy at a given value of D. The operation of each installation is briefly described. A detector for measurements in objects with dimensions less than 0.1 μm is also breifly described. (JSR)

27823 FLUCTUATIONS OF THE ENERGY LOSS OF HEAVY CHARGED PARTICLES IN THIN LAYERS OF TISSUE-EQUIVALENT MATERIALS. Videnskii, V. G.; Pitkevich, V. A. pp 28-31 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

The differential ionization cross sections were calculated on the basis of the binary collision theory for the atoms H, C, N, and O by protons from 0.21 to 14.07 MeV and by α particles from 2.0 to 5.6 MeV. Typical results obtained for C are shown and results obtained for N by protons are compared with experimental data with good agreement. The method used for the calculation of the distribution function of the transmitted energy is outlined. (JSR)

27824 CALCULATION OF THE SPECTRA OF ABSORPTION EVENTS FOR HEAVY CHARGED PARTICLES. Gubin, A. T. pp 31-36 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

The results of the calculation of the spectra of absorption events for monoenergetic protons, α particles, and accelerated B ions using the Monte Carol methods are reported and discussed. A modification of the method in which the trajectory of the delta electrons was assumed to be linear was used in the calculations. The distribution functions $F_1(Z)$ of the local dose Z in one absorption event and the corresponding values of the "mean frequency" Z_F and "mean dose" Z_D are tabulated. (JSR)

27825 DIAGRAM OF THE RANGE OF APPLICABILITY OF COMPUTATIONAL METHODS IN THE MICRODOSIMETRY OF CHARGED PARTICLES. Gubin, A. T.; Kovalev, E. E.; Sakovich, V. A. pp 40-43 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

An analysis of the computational methods used in microdosimetry of charged particles led to the following conclusions on their applicability. Calculation methods not considering the transfer of energy by delta-electrons to protons are usable only in a narrow interval of LET values. With respect to α particles, consideration of the fluctuations transferable on the energy path does not give satisfactory results in camparison with triangular distributions. The consideration of delta-electrons as statistical independents is justified if the dimensions of the microvolume is 0.1 μ or less. The use of the radial distribution of the transferred energy for calculation of dose–effect curves is justified only in cases of multicharged ions with microvolume dimensions more than 10 μ. At microvolume dimensions of 1 μ and below and at LET values of 5 to 500 keV/μ it is necessary to calculate the spectra of absorption events for protons, α particles, and multicharged ions. (JSR)

27826 METHOD FOR THE CALCULATION OF THE SPECTRA OF ABSORPTION EVENTS OF HEAVY CHARGED PARTICLES. Gubin, A. T.; Sakovich, V. A. pp 43-48 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

A calculation method was developed and a computer program was written with which it is possible to obtain data on the spectra of absorption events for monoenergetic heavy charged particles having LET in the range from several keV/μ to 1 MeV/μ and dimensions of the microvolume from 0.1 to 10 μ. (JSR)

27827 DISTRIBUTION OF PRIMARY ACTIVE PARTICLES IN THE TRACK OF A MONOCHARGED ION. Miterev, A. M.; Kaplan, I. G.; Gorisov, E. A. pp 73-77 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

An expression is derived which shows that the track of a heavy monocharged ion can be represented in the form of a cylindrical ion core with a diameter of about 7 Å surrounded by a cone-shaped region of excitation and ionization, formed both by the direct particles and by the effects of secondary electrons. The ionization and excitation density sharply decreases with increase of the distance from the track axis of the primary particle. The concentration of ions and excited particles formed by the effects of secondary electrons changes as a function of the distance from the track axis, approximately as r^2, and slightly increases along the track. The maximum radius of the track decreases with decrease of energy of the particle. (JSR)

27828 USE OF FOURIER TRANSFORMS FOR CALCULATION OF MICRODOSIMETRIC FUNCTIONS. Pitkovich, V. A.; Videnskii, V. G. pp 78-81 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

A method is developed for the calculation of the distribution function of the specific energy absorbed in some microvolume of a given shape and atomic composition and occurring because of the excitation of that microvolume by any form of radiation. (JSR)

27829 ENERGY SPECTRUM OF RECOIL PROTONS EMITTED FROM SPHERICAL LAYERS OF TISSUE-EQUIVALENT MATERIAL DURING IRRADIATION WITH 14.1-MeV NEUTRONS. Pitkevich, V. A.; Videnskii, V. G. pp 83-85 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

A Monte Carlo calculation was made of the energy spectrum and path length distribution of recoil protons emitted from spherical layers of a tissue-equivalent material during neutron irradiation. The results obtained are graphed. The experimental distribution of the path length slightly differs from the theoretical. (JSR)

27830 FLUCTUATION OF THE ENERGY LOSS OF FAST ELECTRONS IN MATTER. Remizovich, V. S. pp 85-88 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From confernce on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

An expression is derived for the fluctuation of the energy loss of electrons with depth. The results obtained at two different depths are compared with those calculated from the Landau theory. (JSR)

27831 DIFFERENT DISTRIBUTION FOR THE PROBABILITY OF ENERGY LOSS DURING IONIZATION AND EXCITATION OF ATOMS IN A SMALL VOLUME. Remizovich, V. S.; Ryazanov, M. I. pp 88-90 of Voprosy Mikrodozimetrii. Ivanov, V. I. (ed.). Moscow; Izdatel'stvo Atomizdat (1974). (In Russian).

From conference on problems in microdosimetry; Moscow, USSR (12 Jun 1973). See CONF-7306124-.

Expressions were derived for the probability of charged particle energy losses during ionization and during excitation. The results obtained were compared with those obtained using the Landau theory of energy loss during ionization. (JSR)

27832 PROKHOZHDENIE BETA-CHASTITS CHEREZ KRISTALLY. (TRANSMISSION OF BETA PARTICLES THROUGH CRYSTALS). Vorob'ev, S. A. Moscow; Atomizdat (1975). 144p.

The transmission of β particles through monocrystals is examined with emphasis on the detection of orientation effects of the interaction. The theoretical principles of the channeling effect of electrons and positrons are described and experimental data on the characteristics of the interaction of β particles with monocrystals are discussed. A theoretical analysis of the channeling effect was based on the representations of the Lindkhard theory and the results of a computer simulation of the effects of charged particle scattering. The effect of mass and sign of the charged particles on interaction processes of electrons and positrons in monocrystals was examined. Some differences in the transmission of electrons and positrons through matter are discussed. The results of studies on the effects of positron annihilation on the order atomic structure were examined in detail. Possible types of positron states in ionic crystals, connected with different types of point defects in the lattice, are analyzed. (tr-auth)

27833 CONCEPTS OF MICRODOSIMETRY. Pt. 2. Probability Distributions of the Microdosimetric Variables. Kellerer, A. M.; Chmelevsky, D. (Columbia Univ., New York (USA). Radiological Research Lab.). Radiat. Environ. Biophys.; 12: No. 3, 205-216(1975).

1 fig.; 27 refs.

This is the second part of an investigation of microdosimetric concepts relevant to numerical calculations. Two different types of distributions of the microdosimetric quantities are discussed. The sampling procedures are considered, which lead from the initial pattern of energy transfers, the so-called inchoate distribution, to the distribution of specific energy and their mean values. The dependence of the distributions of specific energy on absorbed dose is related to the sampling procedures. (DE)

27834 ROLE OF IONS IN PRODUCTION OF CONDENSATION NUCLEI FROM β RAYS. Bricard, J.; Cabane, M. (Paris-6 Univ., 75 (France)); Madelaine, G.; Ollion, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 24, 761-763(23 Jun 1975). (In French)

One irradiates a gas with a β ray source to produce condensation nuclei. The number of condensation nuclei varies with lifetime of the ions produced by the source. (FR)

27835 DETERMINATION OF γ-RAY DEPTH-DOSE DISTRIBUTION IN A POLYETHYLENE SPHERE PHANTOM. Ha, C. W.; Jun, J. S.; Rho, C. S. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 7: No. 4, 285-293(Dec 1975).

A study to determine the depth-dose distribution along the central axis of a polyethylene sphere of 30 cm diameter is described. Depth-dose distribution in the polyethylene sphere for a broad beam of monoenergetic photons has been experimentally determined with a thermoluminescent dosimeter as a cavity dosimeter. The conversion of dose absorbed in the LiF TLD to dose in the surrounding medium was carried out on the basis of Burlin's generalized cavity theory. Presented in graphical forms are the results obtained. The maximum absorbed doses in the sphere were observed at the depth of about 0.3cm and 0.5cm from the surface of the sphere for the γ-rays of ^{137}Cs and ^{60}Co, respectively. (auth)

27836 FLUX DISTRIBUTION CALCULATIONS IN PLANAR CHANNELING. Ellison, J. A. (Univ. of New Mexico, Albuquerque). Phys. Rev., B; 12: No. 11, 4771-4779(1 Dec 1975).

A technique was developed to calculate the spatial and velocity distributions of channeled ions in planar channeling as a function of the depth in a crystal. The continuum plane approximation is assumed but no assumptions about statistical equilibrium are made. At fixed depths, the distributions are found to exhibit both jump discontinuities and infinities, so an integral of the distributions over small intervals around various positions across the channel is calculated. Also, the distributions are found to change considerably with depth and the integrals as a function of depth give a clear picture of the flux-peaking phenomenon. The key idea in this technique is an examination of the motion of the ions in the phase plane; this turns out to be a very systematic way of ordering the particles and thereby gaining insight into the structure of the distributions. The technique is illustrated by examining the evolution of the spatial distribution with depth for channeling of 1-MeV helium ions along the [110] planes of silicon. 11 figures. (auth)

27837 MEASURED RADIAL DISTRIBUTIONS OF DOSE AND LET FOR ALPHA AND PROTON BEAMS IN HYDROGEN AND TISSUE-EQUIVALENT GAS. Wingate, C. L.; Baum, J. W. (Brookhaven National Lab., Upton, NY). Radiat. Res.; 65: No. 1, 1-19(Jan 1976).

Experimental measurements of the radial distribution of dose and radially restricted linear energy transfer (L/sub r/) are reported for alpha and proton beams of 1 to 3 MeV from a Van de Graaff accelerator. The method employs a large cylindrical ionization chamber filled with tissue-equivalent gas (or hydrogen) at variable low pressure for L/sub r/ measurement. For radial dose determination, a small movable ionization chamber of transparent mesh located inside the large cylinder is used to measure ionization by secondary electrons around the charged particle beam. Results are presented for simulated tissue radii from about 10 A to a few thousand angstroms. Comparison of the measured dose distributions with recent calculations by H. G. Paretzke indicates fair agreement except for large radii, where the local energy deposition is a small part of the total. (auth)

Radiation Protection Standards

27838 COMMUNICATIONS. Liden, P. K. (Radiation Physics Department, University Hospital). Med. Phys.; 3: No. 1, 52 (Jan 1976).

The new special names of SI units in the field of ionizing radiations are given. (AIP)

Radiation Source Calibration and Standardization

Refer also to abstracts 26064 and 26068.

Shielding Calculations and Experiments

Refer also to abstract 27613.

PHYSICS (THEORETICAL)

General

Refer also to abstract 27236.

27839 KVAZIKONFORMNYE OTOBRAZHENIYA I RIMANOVY POVERKHNOSTI. (QUASICONFORM REPRESENTATIONS AND RIEMANN SURFACES). Krushkal, S. L. Novosibirsk, USSR; Izdatel'stvo Nauko Sibirskoe Otdelenie (1975). 195p.

The inter-related questions of the theory of quasiconform representations and the theory of Riemann surfaces are examined. The variational methods for the solution of the extremal problem of the theory of quasiconform representations and other application are derived. Questions on the theory of space of Riemann surfaces are studied in connection with uniform convergence and the theory of models of Riemann surfaces. Solutions are given for some problems of the Klein group theory. (tr-auth)

27840 FURTHER STEP IN THE FOLDY–WOUTHUYSEN TRANSFORMATION. Ringhofer, K. Acta Phys. Austriaca; 41: No. 2, 189-195(1975).

It is the purpose of a Foldy-Wouthuysen transformation to separate particle and antiparticle states in the Dirac Hamiltonian. As is well known, the solution of this problem is not unique: a unitary transformation in spin space (a "rotation") remains free. In a fully relativistic linear field approximation, one uses this degree of freedom to separate also the states with "spin up" and "spin down" so that the Foldy-Wouthuysen transformed Hamiltonian for particles separates again into two uncoupled Hamiltonians which look formally like the Hamiltonians for scalar particles. (auth)

27841 INTRODUCTION TO INVARIANT IMBEDDING. Bellman, R.; Wing, G. M. Pure and Applied Mathematics. New York; John Wiley and Sons, Inc. (1973). 264p. $18,95.

The topics discussed include fundamental concepts, additional illustrations of the invariant imbedding method, functional equations and related matters, existence, uniqueness, and conservation relations, random walk, wave propagation, time-dependent problems, the calculation of eigenvalues for Sturm–Liouville type systems, Schroedinger-like equations, applications to equations with periodic coefficients, transport theory and radiative transfer, and integral equations. (JFP)

27842 EIGENFUNCTIONS OF LINEAR COMBINATIONS OF CREATION AND ANNIHILATION OPERATORS. Bagrov, V. G.; Gitman, D. M.; Kuchin, V. A. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 13-19(1975). (In Russian).

The eigenfunctions of linear combinations of creation c^+ and annihilation c operators of the Bose type are examined. The operators were divided into c, c^+, and $(c + c^+)$ type operators. It was shown that the eigenfunctions of c-like operators were normalized but not orthogonalized. The eigenfunctions of $(c + c^+)$-like operators were orthogonalized and normalized into functions. Some examples of $(c + c^+)$-like operators were examined as illustrations. Their eigenfunctions were found and their orthogonality and completeness were shown. (tr-auth)

27843 DENSITY MATRIX OF A HARMONIC OSCILLATOR INTERACTING WITH A TWO-LEVEL SYSTEM. Montaldi, E. (Univ., Milan). Lett. Nuovo Cim.; 15: No. 5, 139-145(31 Jan 1976).

The density matrix of a harmonic oscillator coupled linearly to a two-level system in the representation that diagonalized the Hamiltonian of the oscillator and in lowest-order perturbation theory. Using Glauber's R function as a generating function for the matrix elements, the equation for R is solved following a previous approach. (JFP)

27844 RELATION BETWEEN THE PARTICLE-LIKE SOLUTIONS OF THE CLASSICAL EQUATIONS AND THE QUANTUM PARTICLES. Tyupkin, Yu. S.; Fateev, V. A.; Schwarz, A. S. (Moscow Engineering-Physics Inst.). Yad. Fiz.; 22: No. 3, 622-631(Sep 1975). (In Russian).

Some general relations between the particle-like solutions of the classical nonlinear equations and the quantum particles are presented taking an exactly solvable model as an example—the nonlinear Schroedinger equation and its quantum analog. (auth)

27845 BOHM–AHARONOV EFFECT AND PRINCIPLE OF LOCALITY IN QUANTUM MECHANICS. Vainshtein, A. I.; Sokolov, V. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yad. Fiz.; 22: No. 3, 618-621(Sep 1975). (In Russian).

The principle of locality of interactions in the quantum theory is discussed in view of the interpretation of the Bohm–Aharonov effect. In framework of the nonrelativistic quantum mechanics this principle is formulated in terms of the Heisenberg equations of motion for the coordinate and velocity operators. The equations contain only field intensities and no potentials. It follows from the equations that the forces influence the motion, if the distance between the center of the wave packet and the region, where the forces exist, is less than the smr of the packet size, even if the wave function is negligibly small in this region. (auth)

27846 MINIMAL-UNCERTAINTY STATES FOR THE GENERALIZED OSCILLATOR PHASE OPERATORS. Papaloucas, L. C. (International Center for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 15: No. 9, 317-320(28 Feb 1976).

The uncertainty product is studied for a large class of generalized oscillator phase operators C and S (cosine and sine). The quantum mechanical problem whether there exist normalizable states which minimize the uncertainty product $(\Delta C)\,(\Delta S)$ is investigated in this case. It is concluded that even in the case of the generalized oscillator phase operators C and S constructed from sequences monotonically convergent to unity from below, one cannot find normalizable states that minimize the uncertainty product $(\Delta C)\,(\Delta S)$. (JFP)

27847 GENERALIZED WRONSKIAN RELATIONS, ONE-DIMENSIONAL SCHROEDINGER EQUATION AND NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS SOLVABLE BY THE INVERSE-SCATTERING METHOD. Calogero, F. (Univ., Rome). Nuovo Cim., 31B: No. 2, 229-249(11 Feb 1976).

A generalized Wronskian-type relation is used to obtain a number of expressions for the scattering and bound-state parameters (reflection and transmission coefficients, bound-state energies and normalization constants) in the context of the one-dimensional Schroedinger equation. These expressions are in the form of integrals over the wave functions multiplied by appropriate (generally nonlinear) combinations of the potentials and their derivatives. Some of them provide the basis for deriving classes of nonlinear partial differential equations that are solvable by the inverse-scattering method. The main interest of this approach rests in its simplicity and in its delivery of nonlinear evolution equations that may involve more than one (space) variable and contain coefficients that are not constant. (auth)

27848 PATH INTEGRAL FORMULATION FOR EIGENFUNCTIONS. Campbell, W. B.; Finkler, P.; Jones, C. E.; Misheloff, M. N. (Univ. of Nebraska, Lincoln). Nuovo Cim., 31B: No. 2, 219-224(11 Feb 1976).

The path integral technique of quantum mechanics is generalized to provide direct expressions for energy eigenfunctions. The technique is illustrated with the harmonic oscillator.

27849 CONFORMAL SYMMETRY OF THE HAMILTON–JACOBI EQUATION AND QUANTIZATION. Boyer, C. P.; Penafiel, N. M. (Univ. Nacional Autonoma de Mexico, Mexico City). Nuovo Cim., 31B: No. 2, 195-210(11 Feb 1976).

The symmetry group of the time-dependent Hamilton-Jacobi equation for a nonrelativistic free particle in n spatial dimensions is discussed. It is found to be isomorphic with the conformal group of an $(n + 2)$-dimensional Minkowski space. A prescription is given whereby quantization is equivalent to selecting a unitary irreducible representation of the subgroup of linear representations over the space-time manifold. The generalization to arbitrary manifolds and the inclusion of spin are discussed. (auth)

27850 IMPLICATIONS OF THE BOHM–AHARONOV HYPOTHESIS. Ghirardi, G. C.; Rimini, A.; Weber, T. (Univ., Trieste, Italy). Nuovo Cim., 31B: No. 2, 177-194(11 Feb 1976).

It is proved that the Bohm–Aharonov hypothesis concerning largely separated subsystems of composite quantum systems implies that it is impossible to express the dynamical evolution in terms of the density operator. (auth)

27851 PROPERTY OF THE PROJECTION OPERATOR ASSOCIATED TO A MIXTURE OF THE SECOND TYPE. Fortunato, D. (Univ., Bari, Italy). Lett. Nuovo Cim.; 15: No. 9, 289-290(28 Feb 1976).

The following theorem is proven: if H_S and H_T are separable Hilbert spaces, a given inequality holds, where S and T are two quantum mechanical systems, described respectively by the Hilbert spaces H_S and H_T. (JFP)

27852 QUANTUM MECHANICS IN A DISCRETE SPACE–TIME. Welch, L. C. (Technische Hochschule, Aachen). Nuovo Cim., 31B: No. 2, 279-288(11 Feb 1976).

A substitution rule which governs the replacement of derivatives by differences is derived, which leads to equations which have reasonable eigenvalues and commutation relations for several simple physical problems. A dynamical equation is suggested and solved for a finite square-well potential. (auth)

27853 AXIOMATICS OF GENERAL TYPE HAMILTONIAN THEORIES INCLUDING CLASSICAL AND QUANTUM ONES AS PARTICULAR CASES. Shirokov, Yu. M. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 25: No. 3, 307-312(Dec 1975). (In Russian).

The set of axioms of the hamiltonian theory is constructed in the form which is valid for classical and quantum theories as well. These axioms define the algebra with two multiplication operations called the free hamiltonian algebra. Classical and quantum theories are derived as factor algebras corresponding to different equivalence relations. The axiomatics admit essentially new hamiltonian theories with the nonassociative multiplication of the observables. (auth)

27854 MATRIX MECHANICS AS A PRACTICAL TOOL IN QUANTUM THEORY: THE ANHARMONIC OSCILLATOR. Li, C. T.; Klein, A.; Krejs, F. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., D; 12: No. 8, 2311-2324(15 Oct 1975).

For an anharmonic oscillator, it follows from the number of zeros of the exact wave functions as functions of the quantum number n that the matrix elements (n parallel x parallel n') and (n parallel p parallel n') should be rapidly decreasing functions of parallel n-n'parallel. Matrix elements of polynomials in x and p should therefore be well approximated by a finite number of terms in their sum-rule decomposition. From the matrix elements of the equations of motion for x and for p and of the commutator [x,p], one thereby obtains closed sets of nonlinear algebraic equations to characterize subspaces of the Hilbert space of exact eigenfunctions. The approximations are also derived from a novel variational principle, and numerous variant approximation schemes are suggested. Essentially exact numerical results are obtained and compared with previous work. The broad applicability of the techniques is emphasized. (auth)

27855 GROUND-STATE ENERGY OF A ONE-DIMENSIONAL MANY-BOSON SYSTEM. Lee, D. K. (Univ. of Kansas, Lawrence); Lee, F. J. Chin. J. Phys. (Taiwan); 13: No. 2, 188-204(Oct 1975).

The ground-state energy of a one-dimensional system of many bosons interacting via a repulsive δ-function potential is carried out through third-order corrections, when the coupling parameter γ of the system is small. The procedures are basically developed following both the Bogoliubov-Zubarev and the Davison-Feenberg methods. It is seen numerically that a slight difference exists in between, at least, starting from the third-order correction; the former one gives rise to a more improved agreement with the exact results obtained by Lieb and Liniger, and also, the variational contribution in the latter is still dominant even in the third-order correction. (auth)

27856 REMARK ON THE TAKIZAWA-ISIGAKI GENERALIZED SAMPLING THEOREM. Yoshikawa, A. (Hokkaido Univ., Sapporo). Chin. J. Phys. (Taiwan); 13: No. 2, 224-225(Oct 1975).

Discussions are given on the meaning and the implication of the key assumption in deriving the Takizawa-Isigaki sampling formula. (auth)

27857 STATISTICAL DESCRIPTION OF THE MOTION OF PARTICLES TRAPPED BY NONLINEAR WAVE. Berman, G. P.; Zaslavskii, G. M. (Inst. of Physics, Krasnoyarsk, USSR). Teor. Mat. Fiz.; 26: No. 2, 234-245(Feb 1976). (In Russian).

The nonlinear theory of self-consistent motion of particles trapped by the potential pits of nonlinear periodic wave ("penal model") is developed in the framework of the Hamiltonian formalism. The effective nonlinear potential of the two-particle interaction is constructed. With the aid of it the kinetic equations of the Fokker-Planck type are derived. The kinetics of trapped particles in ergodic layer near the separatrice and its influence on the common kinetics of the trapped particles is considered. The relaxation time for the trapped particles to the equilibrium distribution is determined. (auth)

27858 HYDRODYNAMICAL APPROACH TO QUANTUM PHYSICS. Bagchi, S. N. (Loyola of Montreal). Indian J. Phys.; 58: No. 6, 21-61(Jun 1975).

The fundamental hypothesis of the hydrodynamical approach to quantum physics rests on the fact that the basic empirical observation of quantum phenomena is that a particle possesses simultaneously both corpuscular and wave properties. Renninger's gedanken experiment, the derivation of the generalized equation for the scalar field of a single particle, the generalized Hamilton-Jacobi equation, important special cases of the generalized wave equation, De Broglie relations, Heisenberg uncertainity principle, wave mechanical current density, and the properties of free quantum vortices physical models for elementary particles are discussed. (JFP)

27859 ON THE EXISTENCE OF A CLASS OF STATIONARY QUANTUM STOCHASTIC PROCESSES. Lewis, J. T. (Dublin Inst. for Advanced Studies (Ireland). School of Theoretical Physics); Thomas, L. C. (University Coll. of Swansea (UK)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 3, 241-248(1975).

Given a classical stationary stochastic process, a corresponding quantum stochastic process is constructed. As an example, the Ornstein-Uhlenbeck process is used to construct the quantum process whose existence was suggested by the work of Ford, Kac and Mazur. (FR)

27860 ON THE APPROACH TO THE CRITICAL POINT. Glimm, J. (Rockefeller Univ., New York (USA)); Jaffe, A. (Harvard Univ., Boston, Mass. (USA)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 2, 109-122(1975).

The mass perturbation yields a new construction for $P(\phi)_2$ = Even + Linear quantum field models. For ϕ^4 models, the Schwinger functions are differentiable in the parameters $\sigma = \delta\, m^2$, in the single phase region, and are continuous as σ tends to $\sigma(c)$. For the Ising(d) model, $d \geq 2$ classical bounds on the critical exponents, e.g. $1 \leq \gamma \leq 2\nu$, are a consequence of an Ornstein-Zernike type upper bound on the two point function. (FR)

27861 CANONICAL TRANSFORMATIONS, TREES, AND MOMENTA DIVISIBLE BY 1/4. Knyr, V. A.; Pipirayte, P. P.; Smirnov, Yu. F. (Moscow State Univ.). Yad. Fiz.; 22: No. 5, 1063-1072(Nov 1975). (In Russian)

It is shown that the transformation matrices between real hyperspherical harmonics which correspond to various trees (tree coefficients) coincide with j symbols for the group of canonical transformations Sp(2, R). Those j symbols involve momenta divisible by 1/4 and are analytical continuation of usual j symbols. (auth)

27862 USE OF LOCALIZED CANONICAL SOLUTIONS OF THE HARTREE-FOCK EQUATIONS IN MANY-BODY PERTURBATION THEORY. Domany, E.; Katriel, J. (Nuclear Research Centre-Negev, Beer Sheba, Israel). pp 221-226 of Liquid and Solid Helium. Kuper, C. G. (ed.). New York; John Wiley and Sons, Inc. (1975). See CONF-740725-.

The existence of localized canonical solutions of the Hartree-Fock equations is investigated. Application of a prescription proposed by Davidson provides the modification needed to settle the difficulties investigated by Brandow in the context of the theory of solid ^{3}He.

27863 CERTAIN THEORIES OF MULTIPLE SCATTERING IN RANDOM MEDIA OF DISCRETE SCATTERERS. Olsen, R. L. (Dept. of Communications, Ottawa); Kharadly, M. M. Z.; Corr, D. G. Radio Sci.; 11: No. 1, 21-37(Jan 1976).

New information is presented on the accuracy of the heuristic approximations in two important theories of multiple scattering in random media of discrete scatterers: Twersky's "free-space" and "two-space scatterer" formalisms. Two complementary approaches, based primarily on a one-dimensional model and the one-dimensional forms of the theories, are used. For scatterer distributions of low average density, the "heuristic" asymptotic forms for the coherent field and the incoherent intensity are compared with asymptotic forms derived from a systematic analysis of the multiple scattering processes. For distributions of higher density, both in the average number of scatterers per wavelength and in the degree of packing of finite-size scatterers, the analysis is carried out "experimentally" by means of a Monte Carlo computer simulation. Approximate series expressions based on the systematic approach are numerically evaluated along with the heuristic expressions. The comparison (for both forward- and back-scattered field moments) is made for the worst-case conditions of strong multiple scattering for which the theories have not previously been evaluated. Several significant conclusions are drawn which have certain practical implications: in application of the theories to describe some of the scattering phenomena which occur in the troposphere, and in the further evaluation of the theories using experiments on physical models. (auth)

27864 EXPERIMENTAL INVESTIGATION OF THE SCATTERING OF ELECTROMAGNETIC WAVES FROM A MODEL RANDOM MEDIUM OF DISCRETE SCATTERERS. Olsen, R. L.; Zharadly, M. M. Z. (Univ. of British Columbia, Vancouver). Radio Sci.; 11: No. 1, 39-48(Jan 1976).

The paper describes a new three-dimensional physical model of a random discrete-scatterer medium and presents the results of an experimental investigation to determine the suitability of the model in studies aimed at the evaluation of approximate scattering theory. In contrast to previous models in which the scatterer statistics were indirectly controlled by a physical process, the present model allows the statistics to be directly controlled as in a Monte Carlo computer simulation. It also permits considerable flexibility in the type of scatterers used. The experimental model investigated consisted of a layered slab region of polystyrene foam (142 x 76 x 27 cm) in which polyethylene spheres of 1.27 cm diameter were embedded at random positions.

These positions were generated by computer from a uniform distribution. The medium was scanned by a narrow 35-GHz beam and the randomly varying transmitted field was recorded, sampled, and statistically analyzed. The accuracy of the first and second field moments, determined in experiments on the model with two different average densities of the spherical scatterer, is evaluated. (auth)

Quantum Field Theories

Refer also to abstracts 26967, 27079, 27310, 27452, 27541, 27935, and 27938.

27865 (CNRS-CPT-74-P-639) RECENT PROGRESS IN LAGRANGIAN FIELD THEORY AND APPLICATIONS. Proceedings of the Colloquium Held at Marseille, France, June 24-28, 1974. Korthals-Altes, C. P.; de Rafael, E.; Stora, R. (eds.). (Aix-Marseille-1 Univ., 13 - Marseille (France); Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). 1975. 163p. (CONF-7406119-).

Separate abstracts were prepared for the nine papers presented. (JFP)

For abstracts of individual papers see: 27419, 27420, 27445, and 27866-27871.

27866 (CNRS-CPT-74-P-639, pp 6-18) RENORMALIZATION OF GAUGE FIELD MODELS. Becchi, C.; Rouet, A.; Stora, R. (CNRS, Marseille). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

Some recent technical progress in the study of renormalizable gauge field models is considered. A new approach to gauge field models based on a previous renormalization scheme and making extensive use of the quantum action principle recently proved in this framework is given. The quantum action principle is summarized in this framework, and a simple application of the global symmetry problem is discussed, the symmetry property of the gauge field Lagrangians in the tree approximation is exhibited, and it is discussed how this property is preserved at the quantum level. Lastly a rapid review of the main results relative to the Abelian and Higgs-Kibble models is given. (JFP)

27867 (CNRS-CPT-74-P-639, pp 21-28) SOME CONSIDERATIONS ON NONRENORMALIZABLE INTERACTIONS. Parisi, G. (Columbia Univ., New York). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

A particular class of nonrenormalizable interactions is studied in the infinite cutoff limit. Arguments are presented which suggest that the theory is finite after the introduction of a finite number of counter terms. The Green functions are not C/sup infinity/ in the coupling constant at the origin. The same results are obtained using three different techniques: infinite resummation of Feynmann graphs in perturbation theory, analogies with second order phase transitions, the use of the renormalization group equation to define the theory. (auth)

27868 (CNRS-CPT-74-P-639, pp 30-40) SUPERGAUGE SYMMETRY IN LOCAL QUANTUM FIELD THEORY. Ferrara, S. (CERN, Geneva). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

The possible role of supergauge symmetry in conventional local quantum field theory is investigated. It is found that supergauge transformations are those transformations of the enlarged space $(x, \theta, \bar{\theta})$ which leave invariant the lightlike distance $W^2(z) = 0$. (JFP)

27869 (CNRS-CPT-74-P-639, pp 68-77) TWO LOOP DIAGRAMS IN YANG-MILLS THEORY. Jones, D. R. T. (Oxford Univ.). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

A calculation of the renormalization constants of the Yang-Mills field to $O(g^4)$ is presented. The function $\beta(g)$ is hence evaluated to $O(g^5)$ and possible implications for gauge theories of the strong interactions discussed. (auth)

27870 (CNRS-CPT-74-P-639, pp 78-98) MIXING OF OPERATORS IN WILSON EXPANSIONS. Sarkar, S. (CERN, Geneva). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

The tree-loop theorem of 't Hooft and Veltman is used in Fermi type gauges to show that gauge invariant operators in Wilson expansions mix in general with nongauge invariant operators. Background field gauges are proposed in which this does not occur. Calculations of anomalous dimensions in these gauges are discussed. (auth)

27871 (CNRS-CPT-74-P-639, pp 102-124) YANG-MILLS FIELDS ON A LATTICE AND DUAL AMPLITUDES. Korthals-Altes, C. P. (CNRS, Marseille). 1975.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In recent progress in Lagrangian field theory and applications.

Colored U(n) Yang-Mills fields are coupled through a coupling constant g to quarks. The theory is quantized on a d-dimensional cubic lattice. Expanding in n^{-1}— keeping g^2n fixed— gives as leading contribution in the quark-antiquark sector a string type amplitude. The theory obeys the area rule of Wilson, Kogut, and Susskind for values of g with $2g^2n > x(d)$, where x(d) is related to the number of ways a simply connected surface with a given border and fixed large area can be realized. From the requirement that the lattice length be much smaller then a typical hadronic distance follows $2g^2n \approx 1$. For x(d) one has only a very generous bound: $x(d) \geq 2d-3$. (auth)

27872 (CNRS-CPT-74-P-639, pp 6-18) RENORMALIZATION OF GAUGE FIELDS MODELS. Becchi, C.; Rouet, A.; Stora, R. 1974.

From colloquium on recent progress in Lagrangien field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28, 1974. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique).

A new approach to gauge field models is described. It is based on the Bogoliubov-Parasiuk-Hepp-Zimmermann (BPHZ) renormalization scheme making extensive use of the quantum action principle, and the Slavnov invariance. The quantum action principle being first summarized in the framework of the BPHZ is then applied to a global symmetry problem. The symmetry property of the gauge field Lagrangians in the tree approximation is exhibited, and the preservation of this property at the quantum level is discussed. The main results relative to the Abelian and SU(2) Higgs-Kibble models are briefly reviewed. (FR)

27873 (CNRS-CPT-74-P-639, pp 21-28) SOME CONSIDERATIONS ON NON RENORMALIZABLE INTERACTIONS. Parisi, G. 1974.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28, 1974. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique).

A particular class of non renormalizable interactions is studied in the infinite cutoff limit. Arguments presented suggest that the theory is finite after the introduction of a finite number of counter terms. The Green functions are not C (infinite) in the coupling constant at the origin. The same results are obtained using three different techniques: infinite resummation of Feynman graphs in perturbation theory, analogies with second order phase transitions, the use of the renormalization group equation to define the theory. (FR)

27874 (CNRS-CPT-74-P-639, pp 30-40) SUPERGAUGE SYMMETRY IN LOCAL QUANTUM FIELD THEORY. Ferrara, S. 1974.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28, 1974. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique).

The extension of supergauge symmetry to four-dimensional space-time allows to investigate the possible role of this symmetry in conventional local quantum field theory. The supergauge algebra is obtained by adding to the conformal group of space-time two Majorana spinor generators and the chiral charge. The commutation properties of the algebra are used to derive the most general form of the superfield. This field contains two Majorana spinors, two scalar fields, a chiral doublet, and a real vector field called the vector superfield. The covariant derivatives defined, together with the scalar and vector multiplets are the basic ingredients used in order to build up supergauge symmetric Lagrangians. It is shown that the only possible fields which can be considered as supergauge invariant Lagrangians are the F and D components of the scalar and vector multiplets respectively. (FR)

27875 (CNRS-CPT-74-P-639, pp 44-55) ASYMPTOTIC NEAR FREEDOM. Bailin, D. 1974.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28, 1974. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique).

It is proved that the characteristic power deviations from scaling of the theories which are not asymptotically free should be detectable in the N.A.L. muon experiments. The Yukawa theories here considered have SU(3) non-singlet structure function moments varying as a power of $-q^2$, namely $(-q^2)$ at power $-p$. The maximum value of p is determined to be $\frac{2}{3}$: SU3 and 1: SU2. The outstanding question is whether the Yukawa theories considered do in fact have fixed points satisfying the inequalities, and thus simultaneous (non-trivial) zeroes of $\beta(g)$ and $\beta(\lambda)$ have to be found. (FR)

27876 (CNRS-CPT-74-P-639, pp 68-77) TWO LOOP DIAGRAMS IN YANG MILLS THEORY. Jones, D. R. T. 1974.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28, 1974. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique).

A calculation of the renormalization constants of the Yang Mills field to $0(g^4)$ is presented. The function $\beta(g)$ is hence evaluated to $0(g^5)$ and possible implications for gauge theories of the strong interactions discussed. (FR)

27877 (CNRS-CPT-74-P-639, pp 78-98) MIXING OF OPERATORS IN WILSON EXPANSIONS. Sarkar, S. 1974.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28, 1974. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique).

The tree-loop theorem of 't Hooft and Veltman is used in Fermi type gauges to show that gauge invariant operators in Wilson expansions mix in general with non-gauge invariant operators. Background field gauges are proposed in which this does not occur. Calculations of anomalous dimensions in these gauges are discussed. (FR)

27878 (CNRS-CPT-74-P-639, pp 102-124) YANG-MILLS FIELDS ON A LATTICE AND DUAL AMPLITUDES. Korthals-Altes, C. P. 1974.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28, 1974. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique).

Colored U(n) Yang-Mills fields are coupled through a coupling constant g to quarks. The theory is quantized on a d-dimensional cubic lattice. Expanding in n^{-1}—keeping g^2n fixed—gives as leading contribution in the quark-antiquark sector a string type amplitude. The theory obeys the area rule of Wilson, Kogut and Susskind for values of g with $2g^2n > x(d)$, where x(d) is related to the number of ways a simply connected surface with a given border and fixed large area can be realized. From the requirement that the lattice length be much smaller then a typical hadronic distance follows $2g^2n$ not 1. For x(d) there is only a very generous bound: $x(d) \geq 2d-3$. (FR)

27879 (CNRS-CPT-74-P-639, pp 126-148) QUARK CONFINEMENT. Wilson, K. G. 1974.

From colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In proceedings of the colloquium on recent progress in Lagrangian field theory and applications. Held at Marseille, June 24-28, 1974. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique).

A model of confined quarks is presented. It involves an abelian (or non-abelian) gauge field coupled to a quark field. The theory is quantized on a discrete space-time lattice. It shows quark confinement for strong coupling. Specifically, for strong coupling, isolated quarks have infinite mass and quark-antiquark pairs with a large separation r have an energy proportional to r. The theory has local gauge invariance as an exact symmetry in strong coupling theory is far from covariant due to the lattice. (FR)

27880 (CNRS-CPT-75-P-731) LOCAL ALGEBRAS IN EUCLIDEAN QUANTUM FIELD THEORY. Guerra, F. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique). Jun 1975. 23p. INIS.

From conference on Cx algebra and its applications in theoretical physics; Rome, Italy (12 Mar 1975).

The general structure of the local observable algebras of Euclidean quantum field theory is described, considering the very simple examples of the free scalar field, the vector meson field, and the electromagnetic field. The role of Markov properties, and the relations between Euclidean theory and Hamiltonian theory in Minkowski space-time are especially emphasized. No conflict appears between covariance (in the Euclidean sense) and locality (in the Markov sense) on one hand and positive definiteness of the metric on the other hand. (FR)

27881 (ORO-3992-246) RENORMALIZATION OF A DISTORTED GAUGE: INVARIANT THEORY. Hsu, J. P.; Underwood, J. A. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1976. 26p. Dep. NTIS $4.00.

A new type of renormalizable theory involving massive Yang-Mills fields whose mass is generated by an intrinsic breakdown of the usual local gauge symmetry is considered. However, the Lagrangian has a distorted gauge symmetry which leads to the Ward-Takahashi (W-T) identities. Also, the theory is independent of the gauge parameter xi. An explicit renormalization at the one-loop level is completely carried out by exhibiting counter terms, defining the physical parameters and computing all renormalization constants to check the W-T identities. (auth)

27882 DENSITY MATRICES IN QUANTUM SYSTEMS AT INFINITE TEMPERATURE. Wehrl, A. (Univ., Vienna). Acta Phys. Austriaca; 41: No. 2, 197-219(1975). (In German)

The von Neumann algebra of a quantum system with infinitely many degrees of freedom at infinite temperature is a type II_1 factor. For this algebra one develops a theory of density matrices based on the work of Uhlmann for finite-dimensional density matrices. To every density matrix A is attached a function A(x) $(0 \leq x \leq 1)$ defined as follows: $A(x) = {}^{Tr}Ap$, the supremum being taken over all projectors with trace x. The properties of this function are discussed. One introduces a pre-order relation: a density matrix A is said to be more mixed than another one, say B, if $A(x) \leq B(x)$. One investigates the connection between this notion and the behavior of suprema and infima of linear functionals, or traces of convex and concave functions, resp. Finally it is shown that the investigation of general normal states essentially can be reduced to the investigation of density matrices. (auth)

27883 WILLIAMS-WEIZSACKER METHOD AND SIMILAR APPROXIMATION METHODS IN QUANTUM ELECTRODYNAMICS. Kessler, P. (College de France, Paris). Acta Phys. Austriaca; 41: No. 2, 141-188(1975).

The Williams-Weizsacker method (nowadays also called "equivalent photon method"), its history, its various formulations and its many applications in high energy physics are described. Three different proofs are given of the Williams-Weizsacker approximation formula; one is based on classical electromagnetism, the second one on standard Feynman diagram calculation in quantum electrodynamics, and the third one on a generalized (invariant) helicity method. Several applications are discussed in detail, in particular: Nuclear interactions of underground cosmic ray muons; inelastic scattering of high energy particles, in accelerators, through the electromagnetic field of nuclear targets; photon-photon collisions in electron-positron storage rings. The method of quasi real processes, an extension of the Williams-Weizsacker method to processes where various virtual particles other than photons (in particular, electrons) are exchanged, is also described, and some of its applications are shown. (auth)

27884 PRODUCT SPACES AND NELSON'S INEQUALITY. Faris, W. G. (Battelle Inst., Geneva). Helv. Phys. Acta; 48: 721-730(1975).

Certain inequalities for unbounded linear operators in L^2 extend to product spaces. This product space property is used to give a new proof that Gross's inequality for matrices implies Nelson's inequality for ordinary differential operators, and that this in turn implies Nelson's inequality for partial differential operators in infinitely many dimensions. A new proof of Gross's inequality is given. There is also a discussion of the physical meaning of Nelson's inequality in quantum field theory. This article may serve as an introduction for non-specialists to some of the recent mathematical work in this subject. (auth)

27885 QUANTUM ELECTRODYNAMICS. Bialynicki-Birula, I.; Bialynicka-Birula, Z. International Series of Monographs in Natural Philosophy. Volume 70. Oxford; Pergamon Press Ltd. (1975). 562p. $23.00.

Translated from the Polish by Eugene Lepa.

The topics discussed are the general principles of quantum theory, nonrelativistic quantum mechanics, the classical and

quantum theory of the electromagnetic field, relativistic quantum mechanics of electrons, formulation of quantum electrodynamics, renormalization theory, and applications of quantum electrodynamics. (JFP)

27886 ON THE DUALITY CONDITION FOR QUANTUM FIELDS. Bisognano, J.J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Wichmann, E.H. J. Math. Phys. (N.Y.) 17: No. 3, 303-321 (Mar 1976).

A general quantum field theory is considered in which the fields are assumed to be operator-valued tempered distributions. The system of fields may include any number of boson fields and fermion fields. A theorem which relates certain complex Lorentz transformations to the *TCP* transformation is stated and proved. With reference to this theorem, duality conditions are considered, and it is shown that such conditions hold under various physically reasonable assumptions about the fields. Extensions of the algebras of field operators are discussed with reference to the duality conditions. Local internal symmetries are discussed, and it is shown that these commute with the Poincaré group and with the *TCP* transformation. (auth)

27887 GAUGE-COVARIANT DIFFERENTIATION AND GREEN'S FUNCTIONS FOR THE YANG-MILLS FIELD. Frey, H. (Physikalisches Institut der Universität Bonn, Germany). J. Math. Phys. (N.Y.) 17: No. 3, 322-330 (Mar 1976).

A gauge-independent definition of differentiation is given for non-Abelian gauge fields in terms of parallel translation. This is achieved by a suitable definition of time-ordered operator products. Equal time commutation relations are used to derive the differential equations for the related Green's functions. The Green's functions are discussed for general linear gauges. In comparison with electrodynamics the Green's functions have the well-known ghost-loop terms. (auth)

27888 STUDY OF A TWO-DIMENSIONAL MODEL WITH AXIAL-CURRENT-PSEUDOSCALAR DERIVATIVE INTERACTION. Rothe, K.D.; Stamatescu, I.O. (Institut für Theoretische Physik der Universität Heidelberg, Heidelberg, Germany). Ann. Phys. (N.Y.) 95: No. 1, 202-226 (Nov 1975).

A detailed study is made of a massive pseudoscalar field interacting via derivative coupling with massless fermions in two-dimensional space-time. The model provides an example of a soluble renormalizable theory with an anomalous axial-vector current and a zero-mass particle interpretation for the fermion. Except for a finite mass and wavefunction renormalization, the boson remains free in the presence of the interaction. The canonical fermion field exhibits an anomalous dimension that is found to be in agreement with the asymptotic Callan-Symanzik equation. The connection between the Wilson expansion for defining operator products in this model and the Dyson equations of renormalized perturbation theory is discussed, and agreement with second-order perturbation theory is verified by explicit calculation. (auth)

27889 MACROSCOPIC QUANTUM ELECTRODYNAMICS. Favro, L.D.; Kuo, P.K. (Department of Physics, Wayne State University, Detroit, Michigan 48202). Phys. Rev. A 13: No. 3, 1104-1114 (Mar 1976).

We investigate the quantum electrodynamics of many-body systems, and discuss the circumstances under which the results are identical to the results of classical electrodynamics. This classical behavior is shown to occur when the motion of a large number of the particles is correlated. The correlation manifests itself in a form of coherence which is characterized by the many-body quantum state's being very nearly an eigenstate of the current operator. We present several explicit examples of quantum states which exhibit such coherence and show that they give the expected classical results. Nowhere do we assume $\hbar \to 0$. (auth)

27890 CONSTRUCTION OF QUANTUM FIELDS FROM EUCLIDEAN TENSOR FIELDS. Yao, T.H. (Mathematics Department, Bedford College, Regent's Park, London NW1, England). J. Math. Phys. (N.Y.) 17: No. 2, 241-247 (Feb 1976).

We define Euclidean tensor fields over $S(\mathbb{R}^4)$, from which we construct quantum tensor fields satisfying all the Wightman axioms except the uniqueness of the vacuum. By a process of reduction, it is possible to obtain, from some suitably chosen Euclidean tensor field, a quantum field satisfying all the Wightman axioms except the uniqueness of the vacuum and transforming according to any arbitrarily chosen one-valued finite-dimensional irreducible representation of the restricted Lorentz group $L^{\uparrow}_{+}$. We give a Euclidean vector field and a Euclidean tensor field of rank two as examples, leading respectively to the real Proca Wightman field and the free electromagnetic Wightman field. (auth)

27891 BILINEAR QUANTUM FIELD THEORIES AND THEIR COHERENT STATES. DeFacio, B.; Hammer, C.L. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). J. Math. Phys. (N.Y.) 17: No. 2, 267-281 (Feb 1976).

The quantization method developed by Hammer and Tucker, which is based upon a set of equations of motion and their conserved currents rather than a canonical formalism, is extended to interacting systems. The operators of the theory are bilinear and are essentially self-adjoint on a dense domain which is spanned by a suitably chosen subset of the coherent states. Both proper and improper gauge transformations of the second kind are discussed. For the proper case, the connection is given between these transformations and coherent states, which are discussed in detail. One interesting result is that a "smeared" Fock space can be constructed for a system where the particles have the same *average* quantum numbers. For the improper case, the gauge transformation of the second kind is related to the purely absolutely continuous measure. The formalism is applied to two examples. One is a Dirac field minimally coupled to a massive vector field, and the other is Klauder's ultralocal models. (auth)

27892 QUANTIZATION OF THE FREE FIELD. Lee, H.W.; Stehle, P. (Physics Department, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. Lett. 36: No. 5, 277-279 (2 Feb 1976).

The old arguments that persuaded physicists to develop the quantum theory of radiation in the first place are restated in modern terms. They lead one directly to the conclusion that the free field must be quantized in the standard way and that photons are bosons. These conclusions cannot be avoided even though in many applications semiclassical theory leads to very accurate results. (auth)

27893 MASS OF THE HIGGS BOSON. Weinberg, S. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 36: No. 6, 294-296 (9 Feb 1976).

The stability of the vacuum sets a lower bound of order $\alpha G_F^{-1/2}$ on the Higgs-boson mass. For the simplest SU(2) ⊗U(1) model, this lower bound is $1.738\alpha G_F^{-1/2}$, or 3.72 GeV. (auth)

27894 REGGEON FIELD THEORIES AND NONZERO VACUUM EXPECTATION VALUES. Venturi, G. (Univ., Bologna). Lett. Nuovo Cim.; 15: No. 5, 157-160(31 Jan 1976).

A satisfactory nonrelativistic reggeon theory is obtained by starting from a relativistic one, examining its nonrelativistic limit and allowing a nonzero vacuum expectation value for the pomeron field. The introduction of secondary trajectories in such a context is also studied. A simple relativistic Lagrangian illustrates the approach. (JFP)

27895 VARIATIONAL PRINCIPLES AND MATRIX APPROXIMANTS IN POTENTIAL THEORY. Turchetti, G. (Univ., Bologna). Lett. Nuovo Cim.; 15: No. 5, 129-133(31 Jan 1976).

Following a previous method it is shown that a suitable ansatz in the Lipmann–Schwinger variational principle yields a sequence of matrix approximations with the following properties: the lowest matrix approximation is the 1/1 matrix Pade approximation defined, the matrix approximations converge to the K or T matrices, and the matrix approximations have extremal properties in the off-shell momenta. The aim of the method is to give an accurate result with a low number of terms of the perturbation expansion, a crucial aspect for any field theoretical application. (JFP)

27896 POST-ACCELERATION AND ENERGY BALANCE IN THE TIME-DELAYED LORENTZ EQUATION. Kapusta, J. (Univ. of California, Berkeley). Nuovo Cim., 31B: No. 2, 225-228(11 Feb 1976).

The time-delayed Lorentz equation suggested by Cohn is applied to the problem of a constant force which acts for a finite time, and an exact solution is obtained. Whereas the Lorentz equation predicts pre-acceleration, the Cohn equation predicts a runaway post-acceleration. The energy balance of the time-delayed theory is found to be of an unreasonable form. (auth)

27897 EQUATIONS OF ELECTRODYNAMICS IN SPHERICAL WORLD. Pestov, A. B.; Chernikov, N. A.; Shavokhina, N. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 25: No. 3, 327-334(Dec 1975). (In Russian).

It is proved that in the arbitrary Riemannian world the Maxwell equations and the Lorentz condition can be written in spinor form. The five-dimensional approach to the equations of electrodynamics in the spherical De Sitter world is developed. It turns out that the equations take an especially interesting form when the Lorentz condition is taken into account. It is shown how the limit transition from the spherical world to the flat world can be performed. The results obtained make it possible to apply to the electrodynamics the "invariant box" method. (auth)

27898 RENORMALIZATION GROUP EQUATIONS IN DIFFERENT RENORMALIZATION SCHEMES. Vladimirov, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 25: No. 3, 335-343(Dec 1975). (In Russian).

Renormalization group equations for the nonnormalized Green functions and invariant charges are presented. The equivalence between different renormalization schemes is used to derive the the relations between the renormalization group functions of these schemes. A simple way to carry out the renormalization group calculations is outlined. (auth)

27899 FIELDS AND OBSERVABLE ALGEBRAS IN MODELS WITH SUPERSELECTION RULES. I. Model with the Abelian

Gauge Group. Khoruzhii, S. S. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 25: No. 3, 291-306(Dec 1975). (In Russian).

Simple models of the Doplicher–Haag–Roberts theory are studied, in which the field algebra and the observable algebra coexist, the latter being defined as the gauge-invariant part of the former. The abelian model with the gauge group SU(1) is considered. Duality for the nets of local algebras is proved in the abelian coherent sectors, using the twisting operation for the field algebras. Intertwining operators of coherent sectors are extended to unitary operators on the Fock space of states according to the Doplicher–Haag–Roberts scheme and the commutation relations are derived for these unitary extensions. It turns out that in the abelian model all the intertwining operators satisfy normal commutation relations and can be interpreted as boson or fermion fields in correspondence with the number of the charge quanta they transport. (auth)

27900 HAMILTONIAN TREATMENT OF A QUANTUM SCALAR FIELD IN A BIANCHI I UNIVERSE. I. Time-Dependent Operator Theory. Pessa, E. (Univ., Rome). Lett. Nuovo Cim.; 15: No. 9 291-294(28 Feb 1976).

A suitable formalism is constructed in order to give a quantitative form to the ideas of the relation of scalar field quantization in general relativity to particle creation by a gravitational field, the importance of particle creation processes in the dissipation of the anisotropy of the universe, and the hypothesis that particle creation near the singularity could have destroyed the high initial anisotropy simultaneously giving rise perhaps to the entire matter content of the universe and to the formation of galaxies. This construction points toward the establishment of a Hamiltonian formalism. (JFP)

27901 ALTERNATE FORMULATIONS OF CLASSICAL ELECTRODYNAMICS. Bell, R. G. Phys. Rev., D; 12: No. 8, 2266-2268 (15 Oct 1975).

The Lorentz–Dirac, Wheeler–Feynman, and Synge formulations of classical electrodynamics are compared with regard to their equations of motion for charged particles and their treatment of radiation. It is found that the less familiar Synge theory offers a viable alternate to the other two, since it is theoretically consistent and predicts results not at variance with experiment. (auth)

27902 SOLITON "DICTIONARY" FOR MASSIVE QUANTUM ELECTRODYNAMICS. Kaku, M. (City Coll., New York). Phys. Rev., D; 12: No. 8, 2330-2336(15 Oct 1975).

The Thirring model and the sine-Gordon theory in two dimensions were shown to be equivalent. One extends this result by demonstrating the equivalence between massive QED (with self-interacting fermions) and a vector generalization of the sine-Gordon theory. This equivalence is demonstrated by perturbation theory and by constructing the appropriate transformation between the two sets of fields. Because the sine-Gordon equation is known to have classical "kink" or soliton solutions, one is led to suspect that hadrons correspond to extended solutions to the equations of motion in the strong-coupling region. (auth)

27903 SEMICLASSICAL BOUND STATES IN AN ASYMPTOTICALLY FREE THEORY. Dashen, R. F.; Hasslacher, B.; Neveu, A. (Inst. for Advanced Study, Princeton, NJ). Phys. Rev., D; 12: No. 8, 2443-2458(15 Oct 1975).

A semiclassical calculation of the particle spectrum in the Gross–Neveu model was carried out. It is a two-dimensional model with N species of fermions interacting through a symmetrical scalar-scalar interaction and is renormalizable, asymptotically free, and exhibits spontaneous symmetry breaking. A rich spectrum of particles is found which can be interpreted as fermion-antifermion bound states and multifermion bound states. These states fall into supermultiplets whose origin one does not completely understand. The binding mechanism is a vacuum-polarization effect rather than the direct interaction between particles. A general method for handling fermions in semiclassical calculations is developed. (auth)

27904 KINK SOLUTIONS IN TWO SPACE DIMENSIONS. Honerkamp, J.; Patani, A.; Schlindwein, M.; Shafi, Q. (Univ., Freiburg i.B.). Lett. Nuovo Cim.; 15: No. 4, 97-100(24 Jan 1976).

A model in two space dimensions is presented which has an infinite number of kink and antikink solutions. The Lagrangian of this model is described in terms of three real-valued scalar field. (JFP)

27905 SELF-INTERACTING VECTOR FIELDS. Ferretti, B. (CERN, Geneva). Lett. Nuovo Cim.; 15: No. 4, 112-114(24 Jan 1976).

A given Lagrangian density is used to treat self-interaction vector fields, for which the static solution and the equations of motion are discussed. (JFP)

27906 REPRESENTATIONS OF THE SUPERCONFORMAL ALGEBRA. Two-Point and Three-Point Green Functions of Scalar Superfields. Molotkov, V. V.; Petrova, S. G.; Stoyanov, D. Ts. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 26: No. 2, 188-197(Feb 1976). (In Russian).

A certain set of representations of the superconformal algebra is considered. Finite transformations under the superconformal group as well as the two-point and three-point Green functions are found for the case of scalar superfields. The restrictions on anomalous dimensions of the superfields, under which the three-point functions can be different from zero, are also found. (auth)

27907 FINITE-PARTICLE APPROXIMATIONS OF LOCAL FIELD AND THE LOCAL SATURATION PROBLEM. Voronov, B. L.; Skirko, I. F. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 26: No. 2, 175-187(Feb 1976). (In Russian).

Problem of approximating the nontrivial field by finite polynomials over free fields is considered. This problem as well as the well known problem of local saturation of matrix elements of the commutator of fields is reduced to solving the infinite system of equations for the r-functions (nondiagonal matrix elements of the Heisenberg current). The latter corresponds to a definite way (with respect to the number of particles) of breaking off the well known infinite system of axiomatic equations for the r-functions in the local quantum field theory. (auth)

27908 CONSTRUCTION OF EFFECTIVE POTENTIAL IN QUANTUM FIELD THEORY AT FINITE TEMPERATURE. Krasnikov, N. V.; Matveev, V. A.; Tavkhelidze, A. N.; Chetyrkin, K. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 26: No. 2, 172-174(Feb 1976). (In Russian).

A method of constructing the effective potential in quantum field theory at finite temperature is proposed. (auth)

27909 SUPERDIAGRAM TECHNIQUE FOR GAUGE THEORIES. Krivoshchekov, V. K.; Slavnov, A. A.; Faizullaev, B. A. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 26: No. 2, 147-161(Feb 1976). (In Russian).

The diagram technique for supersymmetrical gauge theories is formulated directly in terms of the superfields. Renormalization procedure for such theories is discussed. (auth)

27910 STRONG COUPLING EXPANSION FOR THE GROUND STATE FUNCTIONAL IN THE MODEL OF QUANTUM THEORY OF NEUTRAL SCALAR FIELD WITH THE $g\phi^4$ SELF-INTERACTION IN THE CASE OF THE TWO-DIMENSIONAL SPACE–TIME. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 26: No. 2, 277-281(Feb 1976). (In Russian).

The argumentation is presented which shows that the solution of the equation for the ground state in the case of strong coupling can be expanded into the power series with the respect to the parameter ϵ and the series obtained possesses the positive radius of convergence. (auth)

27911 PARTICLE INTERPRETATION OF THE SCALAR FIELD IN RINDLER SPACE. Garue, S. (Istituto di Fisica del Politecnico, Milan); Montaldi, E. Lett. Nuovo Cim.; 15: No. 11, 380-382 (13 Mar 1976).

A stringent physical argument is suggested which allows one to answer the question whether the particle interpretation of the Klein–Gordon field in Minkowski space and that in Rindler space are or not equivalent. (JFP)

27912 AN EXISTENCE THEOREM FOR A MASSIVE SPIN ONE PARTICLE IN AN EXTERNAL TENSOR FIELD. Velo, G. (Bologna Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Bologna (Italy)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 3, 249-255(1975).

The system of equations describing a massive vector meson in a suitable external tensor field in four dimensional space-time is shown to be essentially equivalent to a symmetric hyperbolic system, to which standard existence theorems can be applied. The results cover the case of sufficiently weak external field and include the situation of non-causal propagation of signals. (FR)

27913 THE FREE EUCLIDEAN MASSIVE VECTOR FIELD IN THE STUECKELBERG GAUGE. Ginibre, J. (Paris-11 Univ., 91 – Orsay (France). Lab. de Physique Theorique et Hautes Energies); Velo, G. (Bologna Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Bologna (Italy)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 3, 257-264(1975).

One defines a free Euclidean massive vector field in close analogy with the Stueckelberg formalism. The propagator has the same high momentum behavior as in the scalar case, and no indefinite metric occurs. One determines the most general injection of the space of Minkowski test functions into the Euclidean one that preserves the transversality condition and has the correct relations with space time translations. This injection is non local in time. (FR)

27914 ABSOLUTE BOUNDS ON VERTICES AND COUPLINGS. Glimm, J. (Rockefeller Univ., New York (USA)); Jaffe, A. (Har-

vard Univ., Boston Mass. (USA)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 2, 97-107(1975).

Absolute upper and/or lower bounds on ϕ^4 and ϕ^6 dimensionless vertices and physical coupling constants are proved. (FR)

27915 INTERNAL SYMMETRY GROUP FOR MASSLESS FIELDS. Strazhev, V. I. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR; 19: No. 9, 792-795(Sep 1975). (In Russian)

It was shown that the field theory of massless particles has an internal symmetry group G = U(1) ⊕ ₛAutU(1), representing the halfline product of the one-parameter group of the chiral (γ_5) transform U(1) in its group of external automorphism. Dual transforms of the electromagnetic field and γ_5 transforms of the neutrino field corresponds to two irreducible groups of chiral transforms. The combined parity operator corresponds to the element of the second order cyclic group AutU(1). (tr-auth)

27916 SPIN-1 VECTOR BOSON STRUCTURE OF FREE SPIN-1/2 QUANTUM FIELD. Garbaczewski, P. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 10, 1113-1117(1975).

Construction of a Fock representation of the CAR algebra in a given Fock representation of the CCR algebra is extended to include physically admissible quantum fields: an example of a free spin-1/2 quantum field constructed from a spin-1 vector boson quantum field is considered. (auth)

27917 RELATIVISTIC PARADOX. Kard, P. (Tartu State Univ.). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 24: No. 2, 173-177(1975). (In Russian)

It was shown that the conceptual test of Einstein leads to a paradox and as a result of the elimination of the paradox a euristic value is lost. (tr-auth)

27918 CALCULATION OF MATRIX-ELEMENTS OF THE DENSITY-OPERATOR FOR THE SUPERPOSITION OF TWO ELECTROMAGNETIC FIELDS. Funke, J.; Hoffman, M. (Freidrich-Schiller-Universitaet, Jena, Ger.). Czech. J. Phys.; 26: No. 2, 134(1976). (In Czech)

A method for calculation matrix-elements of the density operator for the superposition of two electromagnetic fields from the matrix-elements of the two components is developed. In the special case of superposition of a stationary coherent field and a stationary chaotic field results are compared with Peřina's results. (auth)

27919 UNLOC THEORY. Riml, H. O. Princeton, NJ; Princeton Univ. (1975). 70p. University Microfilms Order No. 76-265.

Thesis (Ph. D.).

The convergence of relativistic quantum perturbation theory is examined in the light of the fact that it may be derived from unitarity and causality of the scattering matrix. It is shown that previous arguments given for the divergence of the sum over all Feynman diagrams relies on the interpretation of the Feynman-Dyson expansion being a power series expansion in the coupling constant. An examination of the concept of coupling constant reveals that this interpretation is not necessary. A new one is proposed and its implications examined. There are strong indications that the theory then converges for a discrete value (or possibly values) of the coupling constant. These ideas are then applied to a calculation of the mass spectrum of the strongly stable hadrons. It is proposed that the perfect SU(3) symmetry is broken by a renormalization of the strong coupling constant by electrodynamics. It is indicated how the number of arbitrary parameters may be reduced to a single number of the dimensions of mass. (Diss. Abstr. Int., B)

Gravitation and General Relativity

Refer also to abstracts 26967, 26973, 27021, 27060, and 27078.

27920 (IC-74-116) CONFORMALLY COVARIANT FIELD EQUATIONS. Mickelsson, J.; Niederle, J. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1974. 26p. INIS.

Conformally covariant field equations are defined in an analogous manner to relativistically invariant field equations. To obtain a meaningful definition one takes the fields as Banach valued functions on the conformal closure of the Minkowski space. A standard conformal operator is a conformally covariant operator which is also a nondecomposable relativistically invariant operator in the sense of Naimark. The first- and second-order standard conformal operators and the corresponding differential equations are studied in detail. (auth)

27921 KERR BLACK HOLES IN A MAGNETIC UNIVERSE. Ernst, F.J.; Wild, W.J. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616). J. Math. Phys. (N.Y.) 17: No. 2, 182-184 (Feb 1976).

We present exact expressions for the electromagnetic fields associated with arbitrarily charged Kerr–Newman black holes in a magnetic universe. In the particular case of charge $Q=2\ B_0\ J$, where B_0 is the magnetic field parameter and $J=ma$ is the angular momentum, exact expressions for the gravitational field are also presented, while for arbitrarily charged black holes metrical corrections of order B_0 are evaluated. (auth)

27922 A NEW TOPOLOGY FOR CURVED SPACE-TIME WHICH INCORPORATES THE CAUSAL, DIFFERENTIAL, AND CONFORMAL STRUCTURES. Hawking, S.W. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England); King, A.R.; McCarthy, P.J. J. Math. Phys. (N.Y.) 17: No. 2, 174-181 (Feb 1976).

A new topology is proposed for strongly causal space–times. Unlike the standard manifold topology (which merely characterizes continuity properties), the new topology determines the causal, differential, and conformal structures of space–time. The topology is more appealing, physical, and manageable than the topology previously proposed by Zeeman for Minkowski space. It thus seems that many calculations involving the above structures may be made purely topological. (auth)

27923 NEW IDENTITIES ON THE RIEMANN TENSOR. Cheng, K. (Department of Applied Mathematics, National Chiao-Tung University, Hsinchu, Taiwan 300, Republic of China). J. Math. Phys. (N.Y.) 17: No. 2, 198-199 (Feb 1976).

A set of new identities which involve second covariant derivatives and quadratic forms of the Riemann tensor are proved. These new identities can be thought of as integrability conditions derived from the equations that define the Rieman tensor in terms of the affine connections. (auth)

27924 THE WEYL TENSOR AND STATIONARY ELECTROVAC SPACE-TIMES. Esposito, F.P. (Department of Physics, University of Cincinnati, Cincinnati, Ohio 45221); Glass, E.N. J. Math. Phys. (N.Y.) 17: No. 2, 282-283 (Feb 1976).

It is shown that static electrovac spaces admit only static electric type Maxwell fields, and it is proved that a necessary and sufficient condition for a stationary electrovac space–time to be static is that the Weyl tensor and the Maxwell field tensor both be pure electric type. (auth)

27925 APPLICATION OF CONTINUOUS VARIATION FORMULAS AND DISCRETE INVARIANCE PRINCIPLES TO BLACK HOLES AND NEUTRON STAR MODELS. Carter, B. (Observatoire de Paris-Meudon, 92 Meudon, France). Ann. Phys. (N.Y.) 95: No. 1, 53-73 (Nov 1975).

A discussion is given of the inferences that can be drawn from the application of the principle of time reversal invariance to the equilibrium states of axisymmetric bodies in general relativity, in conjunction with the law relating energy and angular momentum variations in elastic deformations. The concepts of moments of inertia and of the mutual moments of inertia between different components of a multicomponent body are described. Particular attention is given to the case of axisymmetric perfect solid neutron star models with *relaxable* elastic structures, and it is shown that such bodies have equilibrium states with the special property of invariance under simultaneous time and axial angle reversal. Finally, the case of a Kerr black hole is presented as a concrete example of the application of the ensuing formulas. (auth)

27926 EINSTEIN-MAXWELL METRICS ADMITTING A DUAL INTERPRETATION. Tariq, N. (Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, Canada); Tupper, B.O.J. J. Math. Phys. (N.Y.) 17: No. 3, 292-296 (Mar 1976).

Conditions are given under which the metric part of a solution of the source-free Einstein–Maxwell equations may be interpreted as the metric part of a solution with sources. Examples are given of space–times which admit this dual interpretation and also of space–times admitting one interpretation only. (auth)

27927 METRICS OF THE TRAUTMAN–KERR–SCHILD TYPE AND SOME OF THEIR APPLICATIONS. Urbantke, H. (Univ., Vienna). Acta Phys. Austriaca; 41: No. 1, 1-31(1975). (In German)

Properties of the Trautman–Kerr–Schild metrical ansatz are discussed. Applications to find exact solutions of field equations in several situations are reviewed and completed. In particular, KS-type solutions of the Vaidya problem with a shearing ray congruence and KS-type solutions of Freund's massive gravitation are constructed. (auth)

27928 IS GRAVITY GETTING WEAKER. Van Flandern, T. C. Sci. Am.; 234: No. 2, 44-52 (Feb 1976).

Dirac's large-numbers hypothesis and Mach's principle of inertia which both predict that the strength of gravity decreases with time are discussed. Experiments to test this hypothesis such as observations of lunar occultations, lunar laser-ranging measurements and precise radar-ranging measurements are being carried out. Preliminary data indicate that the value of G is decreasing. One implication according to the large-numbers hypothesis is that the number of nucleons in the universe must be in-

creasing at a rate proportional to the passage of time squared. A theory is proposed to account for this phenomena based on the hypothetical existence of a shield against gravity found only in very dense matter. Implications for the theories of special and general relativity are discussed. (BJG)

27929 GENERALIZED EQUATIONS OF INERTIAL GRAVITATIONAL FIELDS. II. Raigorodskii, L. D. (Leningrad Shipbuilding Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 34-37 (1975). (In Russian).

A generalized Lagrangian of inertial and gravitational fields is introduced. Modified field equations are obtained. (tr-auth)

27930 NEWTONIAN AND NON-NEWTONIAN LIMITS OF THE GRAVITATIONAL FIELDS OF THE KERR-NUT TYPE. Koppel, A. A. (Tartu State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 9, 29-34(1975). (In Russian).

The potentials of the nonrelativistic gravitational fields, corresponding to the unified vacuum solution of Kerr-NUT, were calculated. The dependence of the limitation character c on the structures of the parameters of this solution is shown. An example is given indicating the possibility of the existence of a nonrelativistic limit, principally of a new non-Newtonian (vortex) character. The principal aspects of such a limit are discussed. (tr-auth)

27931 INVARIANT TRANSFORMATION OF SPACE IN GENERAL RELATIVITY THEORY, WHICH ARE DETERMINED BY THE REFLECTION OF TEST PARTICLE PATHS. Singatullin, R. S. (Bashkir State Univ., Ufa, USSR). Dokl. Akad. Nauk SSSR; 223: No. 2, 325-327(11 Jul 1975). (In Russian).

The necessary and sufficient conditions are specified in order that all the timelike geodesic lines of V_4 space under identical initial conditions coincide with the timelike world lines of V_4 space. These spaces are called π-spaces. It is shown that the space curvature is completely reflected by a bivector field F_{ij} and a vector field λ^i_j. The case of a complete representation of the curvature is always of physical interest, since it becomes possible in terms of a bivector field F_{ij} to construct an expression for the energy-momentum density of the field and to investigate the motion of bodies within the framework of general-relative-theory space. (SJR)

27932 VELOCITY OF TEST PARTICLES CLOSE TO THE SCHWARZSCHILD SPHERE. Stoyanov, V. I. (Inst. of Astrophysics, Stalinabad, USSR). Dokl. Akad. Nauk Tadzh. SSR; 18: No. 5, 16-18(1975). (In Russian).

The basic result obtained previously, that $u^2 < 1$, was obtained in the present study in a system of Lemetre frame of reference without resorting to the frame of reference used previously. These data and other published data clearly confirm that the randomness of the selection of the frame of reference (and the requirement of covariance of the principles in the special theory of relativity) by no means indicates the physical equivalence of all these frames of reference. (JSR)

27933 GENERALIZED FIELD THEORY OF GRAVITATION. Yilmaz, H. (Preception Tech. Corp., Winchester, MA). Nuovo Cim., 31B: No. 2, 211-218(11 Feb 1976).

It is shown that if, on empirical grounds, one rules out the existence of cosmic fields of Dicke-Brans (scalar) and Will-Nordvedt (vector, tensor) type, then the most general experimentally viable and theoretically reasonable theory of gravitation seems to be a λ-dependent generalization of Einstein and Yilmaz theories, which reduces to the former for $\lambda = 0$ and to the latter for $\lambda = 1$. (auth)

27934 DIRAC MODIFICATION OF EINSTEIN'S THEORY OF GRAVITATION. Lovelock, D. (Univ. of Arizona, Tucson). Lett. Nuovo Cim.; 15: No. 9, 305-308(28 Feb 1976).

The theorem is established that all conformally flat solutions of Dirac gravitational equations have the property that in-geodesics are straight lines. The theorem suggests that Dirac's theory should be modified. (JFP)

27935 EXACT SOLUTION FOR THE QUANTUM THEORY OF A MATERIAL POINT IN AN EXTERNAL LINEARIZED GRAVITATIONAL-WAVE FIELD. Barducci, A. (Univ., Florence); Giachetti, R. Lett. Nuovo Cim.; 15: No. 9, 309-313(28 Feb 1976).

The exact solution is shown for the problem of a material point interacting with an external linearized gravitational-radiation field, and therefore to complete the possible interactions with external observable fields. Possible applications to the investigation of more complex models as the relativistic string and quantum electrodynamics in the presence of external gravitational radiation, which is interesting in astrophysical problems such as the possible use as a tool to measure the emission of gravitational waves from celestial bodies, are noted. (JFP)

27936 ON THE ELECTROMAGNETIC FIELD INVARIANCE IN AN EINSTEIN-MAXWELL SPACETIME ADMITTING A GROUP OF ISOMETRIES. Coll, B. C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 25, 1773-1776(30 Jun 1975). (In French).

A theorem due to Ray and Thompson concerning the Lie derivative of a regular electromagnetic field with respect to a Killing field in an Einstein-Maxwell space-time is generalized to the singular case. (FR)

27937 SPHERICALLY SYMMETRIC CHARGED DUST DISTRIBUTIONS IN GENERAL RELATIVITY. Raychaudhuri, A. K. (Presidency Coll., Calcutta (India)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 3, 229-240(1975).

A discussion of the dynamics of charged dust distributions with spherical symmetry is presented. The general behavior is quite complicated and while for $\rho/\ /\sigma/$ a constant greater than unity there is a collapse of the spatial volume, the circumferential area may show an oscillatory behavior (ρ and σ indicate the matter and charge densities respectively). Again for $\rho/\ /\sigma/$ a constant less than unity, the spatial volume would not in general collapse but the circumferential area may do so. However there cannot be any regular oscillation if ρ/σ be constant. Some static and nonstatic solutions are displayed but excepting a class of static solutions, all these have a singularity at the center of symmetry. A static solution, fitted on one side with a Schwarzschild field and on the other side with the Reissner-Nordstrom metric, shows that a star may have around it a shell of charged dust in equilibrium and the charge mass ratio may have arbitrarily large values for the shell. (FR)

27938 EINSTEIN-DIRAC THEORY IN SPIN MAXIMUM I. Crumeyrolle, A. (Toulouse-3 Univ. 31 (France)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 1, 43-61(1975). (In French).

A unitary Einstein-Dirac theory, first in spin maximum 1, is constructed. An original feature of this article is that it is written without any tetrapod technics; basic notions and existence conditions for spinor structures on pseudo-Riemannian fibre bundles are only used. A coupling gravitation-electromagnetic field is pointed out, in the geometric setting of the tangent bundle over space-time. Generalized Maxwell equations for inductive media in presence of gravitational field are obtained. Enlarged Einstein-Schroedinger theory gives a particular case of this E. D. theory. E. S. theory is a truncated E. D. theory in spin maximum 1. A close relation between torsion-vector and Schroedinger's potential exists and nullity of torsion-vector has a spinor meaning. Finally the Petiau-Duffin-Kemmer theory is incorporated in this geometric setting. (FR)

27939 EQUIVALENCE BETWEEN THE EINSTEIN–CARTAN AND GENERAL RELATIVITY THEORIES IN THE LINEAR APPROXIMATION FOR A CLASSICAL MODEL OF SPIN. Adamowicz, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 11, 1203-1205(1975).

It is pointed out that in the linear approximation of the Einstein–Cartan theory a set of rotating bodies and a fluid with the classical model of spin give the same metric of space-time. (auth)

27940 MONADIC DESCRIPTION OF SYSTEMS OF RECORING AND MAXWELL EQUATIONS. Mitskevich, N. V.; Kalev, D. A. C. R. Acad. Bulg. Sci.; 28: No. 6, 735-738(1975). (In Russian)

In the general theory of relativity there is no total concept of an inertial frame of reference. On the basis of a monad approach expressions are derived for an inertial frame of reference. The expressions clearly show the effect of gravitational-inertial force on the law of electromagnetism. (JSR)

REACTOR TECHNOLOGY AND REGULATION

27941 (ANL-76-6) PHYSICS OF REACTOR SAFETY. Quarterly Report, July–September 1975. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 25p. Dep. NTIS $5.00.

Included are reports on reactor safety research and technical coordination of the RSR safety analysis program by members of the Reactor Safety Appraisals Group, Monte Carlo analysis of safety-related critical assembly experiments by members of the Theoretical Fast Reactor Physics Group, and planning of DEMO safety-related critical experiments by members of the Zero Power Reactor (ZPR) Planning and Experiments Group.

27942 (CONF-750758-(Summ.)) SUMMARIES OF PAPERS PRESENTED AT THE MEETING ON SMALL NUCLEAR REACTORS FOR INDUSTRIAL ENERGY, OAK RIDGE, TENNESSEE, JULY 31, 1975. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. 160p. Dep. NTIS $6.75.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

Separate abstracts were prepared for each of the 11 papers included. (JWR)

For abstracts of individual papers see: 27943–27949, 27963, 27980, 27981, and 28094.

27943 (CONF-750758-(Summ.), pp 3-7) OVERVIEW OF ERDA INVESTIGATIONS ON NUCLEAR INDUSTRIAL ENERGY. Beresovski, T. (Energy Research and Development Administration, Washington, DC). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

A brief survey of ERDA studies on industrial use of nuclear process heat, particularly as supplied by small nuclear plants, is presented. (JWR)

27944 (CONF-750758-(Summ.), pp 10-27) FUTURE INDUSTRIAL ENERGY OPTIONS. Klepper, O. H. (Oak Ridge National Lab., TN). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

Industrial energy options and the potential future role of small nuclear reactors are examined. (JWR)

27945 (CONF-750758-(Summ.), pp 63-72) BARGE-MOUNTED SYSTEMS: SITING CONCEPTS. Scheppele, K. L. (Gibbs and Hill, Inc., New York). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

Concepts are described for siting platform-mounted nuclear plants at the location of industrial facilities where these plants would furnish industrial process heat and/or electrical power. These concepts include a wet emplacement and a dry emplacement situated at a representative industrial site that could be considered typical of sites along navigable canals adjacent to the ocean or along inland waterways.

27946 (CONF-750758-(Summ.), pp 89-94) SMALL NUCLEAR PROCESS HEAT PLANTS. Jones, A. R. (Westinghouse Astronuclear Lab., Pittsburgh). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

The need for small nuclear process heat plants is briefly discussed. The possible economic advantages of cooperative arrangements for larger multi-use plants are pointed out. The current technology of small nuclear plants is reviewed. (JWR)

27947 (CONF-750758-(Summ.), pp 107-117) INDUSTRIAL POTENTIAL FOR NUCLEAR PROCESS STEAM. Barnes, R. W. (Dow Chemical, Midland, MI). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

An assessment of the potential market for nuclear process steam is presented. The potential for barge-mounted small nuclear reactors is briefly discussed. (JWR)

27948 (CONF-750758-(Summ.), pp 139-152) UTILIZATION OF NUCLEAR POWER FOR DEPARTMENT OF DEFENSE INSTALLATIONS. Nida, A. V. (U. S. Army Facilities Engineering Support Agency, Fort Belvoir, VA). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

A study on the economic and environmental considerations of using small nuclear power plants at Dept. of Defense installations is described. The applications considered included electric power generation, process energy, or a combination of both. Preliminary results indicate that nuclear plants may offer an economical alternative to fossil fueled plants. (JWR)

27949 (CONF-750758-(Summ.), pp 153-159) MARKETS FOR SMALL REACTORS. Anderson, T. D. (Oak Ridge National Lab., TN). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

The potential foreign market for small reactors is discussed for both developed countries and the developing countries. (JWR)

27950 (IRS-F-75) OPERATIONAL EXPERIENCES WITH NUCLEAR POWER PLANTS. (Compilation of five reports). Fehndrich, W.; Kutsch, W. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). 1975. 129p. (In German). Dep. NTIS (US Sales Only) $6.00.

The availability of German nuclear power stations is discussed compared with European and American light-water-nuclear power stations. Furthermore, the availability or utilization respectively, is shown as a function of the year of operation and of the unit size (the latter only for the USA) and their tendency as observed during the last 4 years is made evident. The unscheduled shutdowns of light-water nuclear power stations of the past 4 years are analyzed based on publications of the IAEA in Vienna and the ABE-Committees of the German Atomforum. Emphasis is upon the systems mainly affected.

27951 (JUL-1191) COMPARATIVE STUDY FOR END-ENERGY SUPPLY WITH NUCLEAR DISTRICT HEATING AND WITH NUCLEAR LONG DISTANCE ENERGY Dietrich, G. (SEE CODE-3572500 Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Systemforschung und Technologische Entwicklung; Technische Hochschule Aachen (F. R. Germany)). Jul 1975. 169p. (In German). INIS.

75 figs.; 24 tabs.; 163 refs.

The future energy supply of the Federal Republic of Germany will be oriented to secure energy carriers. Moreover economical energy consumption and environmental protection will be a force for an increased application of district heating and nuclear long distance energy. The technics of generation, transport and distribution of the two energy carriers are discussed, as well as a short review of application areas and potentials. The cost comparisons by models show that there are special advantages for both systems. Nevertheless the conclusions from the study favor nuclear long distance energy because of its wide application range in the whole heat market. But there is also the competition with combined heat and power generation on a fossil basis, as practiced in many industrial companies. As a result of a regional analysis of the area Aachen-Moenchengladbach-Koeln, the cost advantages of nuclear long distance energy as a parameter of current prices are confirmed. Nuclear long distance energy, in combination with

the high temperature reactor and a developed technic of catalysts up to temperatures of 900 K, is an energy source which will be independent of regional necessities, secure, non-polluting, and economic. (DE)

27952 (STI/PUB-423) POWER REACTORS IN MEMBER STATES. 1975 Edition. (International Atomic Energy Agency, Vienna (Austria)). 1975. 76p. Dep. NTIS (US Sales Only) $5.00. IAEA $5.00.

Tables are presented giving general information on power reactors operating, under construction, or planned in IAEA member countries.

27953 POTENTIAL OF NUCLEAR ENERGY FOR STEELMAKING. Ind. Heat.; 61: No. 11, 30-32, 34-36(Nov 1974).

The prospects of applying nuclear heat to steelmaking processes are reviewed. The high-temp. gas-cooled reactor can heat He gas to 1400°F which can then be used for endothermic chemical processes. Steam reforming of a light hydrocarbon, such as natural gas, naptha or liquefied coal, will provide a reducing gas, composed of CO and H. This gas could be used to reduce iron oxide which in turn could be melted in an electric furnace powered by the energy of the reactor. A second system utilizes H which could be obtained by either the electrolysis of water or chemical conversion of water. The H could be heated to approximately 1200°F (649°C) in the reactor for the direct reduction of Fe ore. The third system involves the use of nuclear energy to generate electricity and steam for the coke-oven-blast-furnace-B. O. F. plant. The activities in Europe and Japan, as well as various studies and research programmes, are reviewed. (Metals Abstr.)

27954 PROVEN POWER REACTOR SYSTEMS – NOVEL FEATURES AND DEVELOPMENTS IN OPERATION PERFORMANCE, SAFETY AND RELIABILITY. Pre-Report on the Subject of Technical Meeting No. 3. Bugl, J. (Brown, Boveri und Cie A. G., Mannheim (F. R. Germany). Stabsabteilung Kraftwerke/Nuklear-technik). Kerntechnik; 17: No. 9/10, 405-410(Sep 1975). (In German, English).

1 tab.

As the development of nuclear reactors for the generation of electric power started after the end of the Second World War, the prospective use of diverse materials as fuel, moderator and coolant resulted in a wide diversity of design possibilities. Of the 10 nuclear reactor types which were being considered most seriously in those days, only a few have achieved acceptance. This development is best illustrated by listing the nuclear power plants in service, under construction and on order at present, separately by reactor types (table). In the lead at present and for some years to come are the thermal reactors and especially the light water reactors (LWR). In the LWR group the lead is held by the pressurized water reactor (PWR) which accounts for 44% of the installed capacity of all the nuclear power plants in service at present. In the early 1980s this share will increase to 58%, whereas the share of the boiling water reactor (BWR) will increase to only 28% from 23% at present. (DE)

27955 CATALOGUE OF THE WORLD'S NUCLEAR POWER STATIONS 1975. Kempken, M. Atomwirtsch., Atomtech.; 20: No. 10, 517-524(Oct 1975). (In German).

A tabular survey is given on nuclear power plants in 34 countries in operation and under construction as well as those under contract in mid-1975. (DE)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 28113, 28115, 28120, 28127, 28128, 28130, 28143, 28157, 28228, 28229, 28233, 28235, 28239, and 28241.

27956 (INIS-mf-1801) RINGHALS NUCLEAR POWER STATION. (Statens Vattenfallsverk, Stockholm (Sweden)). Mar 1967. 101p. (In Swedish). INIS.

The license application is given for Ringhals nuclear power station, unit one and two. Ringhals 1 is a BWR-type reactor from ASEA-ATOM (Sweden). Ringhals 2 is a PWR-type reactor from Westinghouse. Reasons are given for the siting of the power station owing to communications, population density, meteorology, hydrology and geology. The construction and safety arrangements of each reactor are described. Handling of radioactive wastes from the station and the safety arrangements for reactor accidents are also given. (INIS)

27957 (Juel-Conf-14, pp 11-23) CHARACTERISTIC FEATURES OF THE BOILING-WATER REACTOR. Wallenwein, E. H. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

12 figs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

The advantages of the BWR compared to the PWR are mainly based on the elimination of a steam generator and the thus eliminated operational difficulties. In addition to the reactor components, the system design, core construction and the control of both types of LWR are compared. (DE)

27958 (Juel-Conf-14, pp 103-115) FUEL ELEMENT LAYOUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE LIGHT-WATER REACTOR SYSTEM. Holzer, R. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

6 figs.; 1 tab. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

The object of the fuel element design is to ensure that the integrity of the fuel rods can be guaranteed under all operational and accident conditions. Reliable demands are defined regarding these requirements and are summarized in "design criteria". Fuel element specifications are a result of these criteria, which are to be considered during the construction and which are also expressed in material, product and manufacturing specifications. (DE)

27959 (NP-20793) MIXED OXIDE FUEL: SCOPE, PROCEDURES, AND SCHEDULE FOR GENERIC ENVIRONMENTAL IMPACT STATEMENT AND CRITERIA FOR INTERIM LICENSING ACTIONS. Chilk, S. J. (Nuclear Regulatory Commission, Washington, D. C. (USA)). 11 Nov 1975. 45p. NRC, Washington, DC.

This notice sets forth the Commission's determination that the subject of wide-scale use of mixed oxide fuel in the light water power reactor fuel cycle requires a full assessment of safeguards issues before the Commission's decision is made; specifies the procedures and schedule to be followed for completion of the environmental impact statement on wide-scale use of mixed oxide fuel and for the conduct of the associated hearings; and sets forth criteria under which certain licensing actions can proceed in the interim prior to the Commission's decision on the wide-scale use of mixed oxide fuel.

27960 (NP-20825) FAILURE ANALYSIS OF A 304 STAINLESS STEEL SCHEDULE 80 REDUCER. Final Report. Buchheit, R. D.; Berry, W. E.; Strabel, G. R.; McCall, J. L. (Battelle Columbus Labs., Ohio (USA)). 26 Aug 1974. 67p. Battelle Columbus Labs., OH.

For Yankee Atomic Electric Co., Westboro, MA.

A failure analysis of a Schedule 80 reducer from the Vermont-Yankee boiling water reactor is described. The analysis was conducted using primarily electron and optical metallographic techniques, and electron microprobe, x-ray diffraction, and gamma-ray analytical techniques. The conclusion from the analysis is that the fracture occurred by stress-corrosion cracking due to a high concentration of stresses at a circumferential ID surface machining groove in combination with an unidentified corrodent. The latter stages of the fracture involved a fatigue mode of crack propagation.

27961 (SGAE-2450) RESEARCH ON THERMOHYDRAULIC STABILITY OF STEAM GENERATOR FOR LIGHT WATER REACTORS. Juette, K.; Bruneder, H.; Nevyjel, A. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Abt. Mathematik). Jun 1975. 25p. (In German). (MA-25/75). Dep. NTIS (US Sales Only) $3.50.

The main aim of the experiments was to investigate the thermohydraulic stability of steam generators for light water reactors using U-shaped pipes. To solve this task, a model of a steam generator was tested under a variety of operating conditions as geometry (pipe partition, pipe length, etc.) and physical properties (pressure in the secondary system, temperature of the feeding system, etc.). Parallel to the experimental work theoretical studies were carried out, whereby a computer program was developed for the numerical evaluation, which enabled the prediction on the stability of the steam generator. Experiments with a preheater at the cold end of the U-shaped heating circuits were carried out to investigate the influence of this component on the stability of the system.

27962 DATA BASE DEMONSTRATES FUEL CAPABILITY. Judge, F. D.; Williamson, H. E.; Weiss, D. T. (General Electric Co., San Jose, CA). Electr. World; 185: No. 3, 26-29(1 Feb 1976).

Operating experience with BWR zircaloy-clad UO_2 fuel is reviewed. The confidence in reliability of production nuclear fuel gained from this experience is discussed. (JWR)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 27956, 27958, 27959, 27961, 28113, 28115, 28119, 28126–28128, 28130, 28131, 28137, 28138, 28157, 28227, 28230–28232, 28234, 28236–28238, 28240, and 28242–28244.

27963 (CONF-750758-(Summ.), pp 29-62) CONSOLIDATED NUCLEAR STEAM GENERATOR: PRESSURIZED WATER REACTOR. Smith, W. R. (Babcock and Wilcox, Lynchburg, VA). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

The Consolidated Nuclear Steam Generator (CNSG) reactor concept for industrial energy applications is discussed. Some preliminary studies to determine the economics and competitiveness of the concept are reviewed. (JWR)

27964 (Juel-Conf-14, pp 25-39) CHARACTERISTIC FEATURES OF THE PRESSURIZED-WATER REACTOR. Sommer, D. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

18 figs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

The pressurized-water reactor is characterized by the single-phase state of its moderator. This necessitates a higher coolant pressure (approximately 150 kp/cm^2). As a result of the single-phase state of the coolant, the control of the water chemistry is simplified. Constructionally, it is possible, due to the single-phase system of the coolant, to introduce the control rods from above into the core and thus to increase the mechanical shutdown safety of the reactor. The loss of reactivity with burnup is compensated for by dilution of the neutron absorbing boric acid. (DE)

27965 (NP-20754) GENERAL METHOD TO DEVELOP MULTI-FREQUENCY BI-AXIAL TEST INPUTS FOR BI-STABLES. Jarecki, S. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Sep 1975. 76p. Westinghouse Electric Corp., Pittsburgh, PA.

The method to be used to generate test inputs for the multi-directional, "Random Type" (multi-frequency) test input for the Bi-Stable demonstration tests, to supplement prior seismic qualification tests of electrical equipment, is presented.

27966 (WCAP-8189-R) FRACTURE MECHANICS EVALUATION OF THE TRINO REACTOR VESSEL. Mager, T. R.; Bamford, W. H.; Yanichko, S. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Feb 1975. 59p. Westinghouse Electric Corp., Pittsburgh, PA.

Results are presented of the fracture toughness testing of the Trino pressure vessel, and the data are discussed in light of current US regulatory rules. This includes generation of heatup and cooldown curves based on the method of Appendix G of the Summer 1972 Addendum to Section III ASME Code. In addition, a fracture mechanics analysis was performed to demonstrate the integrity of the Trino reactor vessel. The analysis included a fatigue analysis utilizing fracture mechanics parameters, and the determination of critical flaw sizes for design (normal, upset, test) transients and a postulated accident (LOCA) condition. (auth)

27967 CARTRIDGE FILTRATION IN PRESSURIZED WATER. Brooks, N. S.; Chow, E. R. (Sargent and Lundy, Chicago). Chem. Eng. Prog.; 71: No. 12, 62-69(Dec 1975).

An evaluation of the performance, disposal methods, and economics of cartridge type filters in PWR systems is presented. It is concluded that the performance of cartridge filters in PWR's is acceptable but that there are some disposal problems. (JWR)

27968 MATERIALS PERFORMANCE IN OPERATING PRESSURIZED WATER REACTOR STEAM GENERATORS. Weeks, J. R. (Brookhaven National Lab., Upton, NY). Nucl. Technol.; 28: No. 3, 348-355(Mar 1976).

The Inconel-600 tubing in operating pressurized water reactor (PWR) steam generators has developed leaks due to intergranular stress corrosion cracking or a general wastage attack, originating from the secondary side of the tubing. Corrosion has been limited to those areas of the steam generators where limited secondary coolant circulation and high heat flux have caused impurities to concentrate. Wastage or pitting attack has always been associated with local concentrations of sodium hydrogen phosphates, whereas stress corrosion has been associated with local concentration of sodium or potassium hydroxides. The only instance of stress corrosion originating from the primary side occurred on cold-worked tubing when hydrogen was not added to getter oxygen, and LiOH was not added to raise the pH of the primary coolant. All U. S. PWR manufacturers are now recommending an all-volatile treatment of the secondary coolant, whereas many plants operated until recently using a phosphate treatment. Experience in operating plants has shown, however, that removal of phosphate-rich sludge deposits is difficult, and that further wastage and/or intergranular stress corrosion can develop; the residual sodium phosphates gradually convert by reaction with corrosion product hydroxides to sodium hydroxide, which remains concentrated in the limited flow areas. Improvements in circulation patterns have been achieved by inserting flow baffles in some PWR steam generators. Inservice monitoring by eddy current techniques, as recommended in U. S. Nuclear Regulatory Commission Regulatory Guide 1.83, is useful for detecting corrosion-induced defects in the tubing, but irreproducibility in field examinations can lead to uncertainties in interpreting the results. (auth)

27969 OPERATING EXPERIENCE WITH WESTINGHOUSE STEAM GENERATORS. Fletcher, W. D.; Malinowski, D. D. (Westinghouse Electric Corp., Pittsburgh). Nucl. Technol.; 28: No. 3, 356-373(Mar 1976).

Service exposure has been accrued in 66 steam generators tubed with Inconel-600. Localized corrosion coincident with sludge deposition in low flow-velocity zones has been observed. Intergranular cracking has been attributed to stress-assisted caustic corrosion resulting from hydrolysis of condenser inleakage contaminants or sodium phosphate reactions with feedwater corrosion products. Wall thinning or wastage is attributed to the formation of high-concentration sodium phosphate solutions under the sludge blanket. The resistance of Inconel-600 to these corrosion mechanisms is comparable or superior to that of other candidate tube materials. The experience gathered points strongly to environmental and thermal/hydraulic factors rather than materials considerations as the predominant influence on the occurrence of localized corrosion. Mechanical modifications designed to reduce the number of tubes in zones of low flow-velocity are being installed into operating units; current production units have incorporated design features including a flow distribution baffle to improve the thermal/hydraulic conditions over prior models. Rigorous control of feedwater impurities is being applied to reduce the probability of creating a corrosive environment in the steam generators. (auth)

27970 THE EFFECT OF ENERGETIC SHIELDING ON THE EPITHERMAL GROUP CROSS-SECTIONS FOR A PWR PIN. Lutz, D. C. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 181-184(1975). (In German).

4 figs.; 6 tabs.; 8 refs.

Calculations of resonance spectra are reported for a PWR pin. The discrepancies in the results of the two codes GGC-4 and RESAB2 are discussed together with their effect on the calculated group constants. The group constants of the most important uranium and plutonium isotopes are represented for the GGC-4 groups 80 to 95. (DE)

27971 A METHOD FOR STORING ENERGY IN THE THERMAL FORM. Bonnin, J. (to Electricite de France, 75 – Paris). French Patent 2,231,277/A/. 21 May 1973. 12p. (In French).

The thermal energy generated during slack hours by a main energy-generating unit A is partially used for heating a storage fluid flowing in a storage and recovery unit B, and that storage fluid which is preferably water, is stored under pressure in a tank. This can be applied to light water nuclear power stations. (FR)

27972 A SAMPLING DEVICE FOR ANALYSIS OF FLUIDS. Donguy, R. (to CEA, 75 – Paris (France)). French Patent 2,231,286/D/. 21 May 1973. 11p. (In French).

A method is described for taking fluid samples flowing in a pipe. This method is characterized: (1) in that a fluid sample is taken and introduced into a cavity which is heated so as to cause the temperature and pressure conditions of the fluid within that cavity to be the same as in the main circuit; (2) in that said cavity

is subsequently isolated from the main circuit after its thermal stabilization; (3) in that, following that isolation, the casing is cooled in order to lower pressure in the cavity; (4) in that the thickness of one of the walls is reduced to a thin window and the fluid is analyzed through the latter. This can be applied to checking activity in the cooling liquids of nuclear reactors. (FR)

27973 PLANNING, PERFORMING, AND INTERPRETING DYNAMIC MEASUREMENTS IN PRESSURIZED WATER REACTORS. Katz, E. M. Knoxville, TN; Univ. of Tennessee (1975). 379p. University Microfilms Order No. 75-26,722.

Thesis (Ph. D.).

Dynamic tests were performed on the Oconee I nuclear power system at 40, 75, and 95 percent of full power. The tests used pseudorandom binary and multifrequency binary perturbation of reactivity. Recordings were made of the resulting output of plant parameters including neutron power, steam pressure, pressurizer pressure, and reactor coolant outlet temperature. The results are presented in the form of frequency responses which are compared to the frequency responses predicted by a theoretical model of the system. The model parameters were adjusted for improved agreement between theory and experiment. From the parameter adjustment, the Doppler coefficient and effective coefficient of heat transfer from fuel to coolant were identified. Detailed procedures are presented for performing dynamic tests in an operating plant environment with inherent system equipment and with minimal interference to power generation. (Diss. Abstr. Int., B)

27974 TEN YEARS OF OPERATING EXPERIENCE AT THE USSR FIFTIETH ANNIVERSARY NUCLEAR POWER STATION AT NOVOVORONEZH. Grigor'yants, A. N.; Ovchinnikov, F. Ya.; Sedov, V. K. Sov. At. Energy (Engl. Transl.); 38: No. 1, 2-9 (Jan 1975).

Translated from At. Energ. (USSR); 38: No. 1, 3-10(Jan 1975).

Plant specifications, cost and performance data, and construction are described. Reactor control and protection systems are discussed together with radiation protection measures. (DG)

27975 FUEL CYCLE COST ANALYSIS OF Go-ri NUCLEAR POWER PLANT UNIT 1. Chung, C. H. (Seoul National Univ.); Kim, C. H.; Kim, J. S.; Lee, C. K.; Moon, K. S. J. Korean Nucl. Soc.; 7: No. 4, 295-310(Dec 1975).

A system of model price data for the fuel cost estimation of the Go-ri plant is developed. With an application of MITCOST-II computer code the levelized unit fuel costs over the entire lifetime of the plant are evaluated. It is found that the overall levelized unit fuel cost is 7.332 mills/Kwhe and that the uranium ore and enrichment service represent more than 85% of the unit cost, assuming a simple once-through fuel cycle process with no reprocessing of the spent fuel. The effects of the cost fluctuations in these fuel cycle elements and the capacity factor changes are also evaluated. The results indicate that the fuel costs are most sensitive to the variation of uranium ore price. Efforts must, therefore, be employed for the arrangement of cheap and timely supply of uranium ore in order to achieve the economic generation of nuclear power.

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 26562, 26760, 26771, 27953, 28105, 28121–28123, and 28125.

27976 (AERE-R-8204) METHODS FOR THE PREDICTION AND ACHIEVEMENT OF A LOW CIRCUIT ACTIVITY. Faircloth, R.; Knowles, A. N. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1975. 31p. Dep. NTIS (US Sales Only) $4.00. UK £1.00.

While there are about 60,000 fuel pins in the core of an LWR power station, in a comparable HTR there would be over 10^{10} coated particles. This five orders of magnitude disparity in the number of basic fission product retaining units has led to important differences in the approach to the prediction and achievement of a low circuit activity. With the HTR, the very large number of units requires statistical treatment of the failure mechanisms involved in the escape of key fission products from the particles and in the assessment of the distribution in the core of burnup, dose and temperature. The methods created to deal with these factors have proved to be very powerful, leading to a situation in which the distribution of fission products within the core and the probability of experiencing a given release are better known for the HTR than for the metal clad fuel of other thermal systems. This advantage has been exploited and reinforced in the UK studies, first by the development of the technology of particle design (a combination of irradiation testing and theoretical analysis) and second by refining the study of fission product movement. This is a continuing process, but already it has usefully illuminated several aspects of design and operation, ranging from the specification and quality control of the fuel itself to the philosophy of outer containments. A summary of this progress is presented, the account being mainly concerned with normal operation.

27977 (BNWL-CC-1401) CORROSION EVALUATION OF N REACTOR PRESSURE TUBE 1756. Larrick, A. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 26 Oct 1967. 47p. Dep. NTIS $4.00.

Declassified 13 Jun 1973.

N Reactor Zircaloy-2 pressure tube No. 1756 and its associated ASTM A234 steel nozzles were examined for corrosion and hydrogen content after approximately 300 days exposure in-reactor. Visual examination showed tight, adherent, dull black oxides in the pressure tube except for scratching in the bottom due to sliding of fuel and fuel spacers through the tube during charge-discharge operations. Several fretted areas up to $\frac{3}{8}$ inch wide by $\frac{1}{2}$ inch long by up to 13 mils deep were observed at the downstream end—these pits were caused by vibration of the fuel spacers against the pressure tube. Hydrogen levels were fairly constant along the tube length with an average of about 19 ← 6 ppm except at one location. At approximately 30 inches from the front end of the tube a sharp peak to a maximum of 58 ppm hydrogen occurred. The reason for the peak is unknown. (auth)

27978 (BNWL-CC-2101) CORROSION EVALUATION OF N REACTOR PRESSURE TUBE 2455. Larrick, A. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1969. 55p. Dep. NTIS $4.50.

Declassified May 1973.

N Reactor Zircaloy-2 pressure tube No. 2455 and its associated ASTM A234 steel nozzles were examined for corrosion and hydrogen content after approximately 680 days exposure in-reactor above zero power. The data are compared with data from a previous tube removed after approximately 300 days exposure. A visual examination of the ID and OD surfaces indicated adherent, dull black oxides on the pressure tube except for regions in the bottom third of the tube ID where numerous shallow (0.5 mil) scratches were found. These were due to sliding of fuel and fuel spacers through the tube during charge-discharge operations. Accelerated corrosion was not occurring at the scratched areas. Galling was observed at the location near the downstream end of the tube where a fuel rupture occurred; the galling was probably due to either the rupture or the rupture removal operation. Fretting corrosion of the tube at areas of contact between the pressure tube and the downstream spacers appeared to be similar to the fretting corrosion found in the previous tube. (auth)

27979 (CEA-CONF-3099) MEASUREMENTS IN NUCLEAR REACTORS. Geffroy, J.; Bastien, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). 1975. 8p. (In French). INIS.

From annual meeting of the French Society of Heat Engineers; La Baule, France (5 May 1975).

A method used to measure the inner cladding wall temperature of a graphite-gas reactor fuel element is described. A thick fin was obtained by machining a subchannel incompletely or not at all. A chromel-alumel thermocouple (D = 1mm) was set into a hole provided in the fin and crimped in place. The head to the thermocouple being at the base of the fin the temperature t' at this point was measured. Determination by calibration of the thick fin exchange coefficient gave the means to pass from t' to t, the inner cladding wall temperature. The calculated and experimental results obtained in the case of a Chinon-3 fuel element are compared. (FR)

27980 (CONF-750758-(Summ.), pp 73-88) SMALL GAS-COOLED PEBBLE-BED REACTOR. Kakretz, A. E.; Wolke, O. G. (General Electric Co., Fairfield, CT). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

The conceptual design of a 500 MW(t) pebble bed reactor for production of hydrogen and/or steam is described. (JWR)

27981 (CONF-750758-(Summ.), pp 95-105) SMALL COMMERCIAL SIZE HTGR FOR INDUSTRIAL ENERGY APPLICATIONS. McMain, A. T. (General Atomic, San Diego, CA). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

An evaluation of the use of 2000–3000 MW(t) HTGR's for industrial process heat is presented. The flexibility of the HTGR design for a wide range of industrial needs is indicated. (JWR)

27982 (GA-A-13267) POSTIRRADIATION EXAMINATION OF CAPSULES HRB-4, HRB-5, AND HRB-6. Scott, C. B.; Harmon, D. P. (General Atomic Co., San Diego, Calif. (USA)). 28 Nov 1975. Contract E(04-3)-167. 132p. Dep. NTIS $5.45.

A description is given of an experiment to evaluate the irradiation performance of fuel rods fabricated using candidate processes and materials for the large high-temperature gas-cooled reactor (LHTGR) start-up and recycle fuel systems. The GA fuel specimens tested in each capsule consisted of six bonded fuel rods fabricated on prototype production equipment with preproduction candidate matrix and graphite shim materials. The fuel rods were fabricated by the admix-compaction and hot-injection processes and were carbonized in graphite tubes to simulate the in-block curing process envisioned for LHTGR fuel fabrication. The irradiation tests were conducted in the removable beryllium facility of the ORNL High-Flux Isotope Reactor (HFIR), and the capsules were monitored for in-pile fission gas release. The post-irradiation integrity of the 18 fuel rods tested was excellent. Irradiation-induced fuel rod dimensional changes were compatible with the dimensional change behavior of LHTGR near-isotropic moderator graphite. Fertile particle coating failure was attributed to excessive internal gas pressures generated during irradiation to those severe conditions, although matrix/coating interaction was a contributing failure mode. Fissile particles exhibited outer pyrocarbon (OPyC) coating failure levels up to 72.6 percent. High OPyC coating failure levels were attributed to excessive matrix/coating interactions resulting from the surface porosity of the OPyC coatings and the high matrix coke weight to fuel rod surface area ratios. As a result of these and other tests, LHTGR-type fuel rod matrix compositions with low coke weight to fuel rod surface area ratios have been developed to eliminate matrix/coating interactions. These matrix compositions are being tested in subsequent capsule irradiation tests.

27983 (GA-A-13556) FINAL REPORT ON GRAPHITE IRRADIATION TEST OG-2. Price, R. J.; Beavan, L. A. (General Atomic Co., San Diego, Calif. (USA)). 15 Dec 1975. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

Results are presented of dimensional, thermal expansivity, thermal conductivity, Young's modulus, and tensile strength measurements on specimens of nuclear graphites irradiated in capsule OG-2. About half the irradiation space was allocated to H-451 near-isotropic petroleum-coke-based graphite or its subsized prototype grade H-429. Most of these specimens had been previously irradiated. Virgin specimens of another near-isotropic graphite, grade TS-1240, were irradiated. Some previously irradiated specimens of needle-coke-based H-327 graphite and pitch-coke-based P_3JHAN were also included.

27984 (GA-A-13778) COMPONENT AND SYSTEMS DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 31 Jan 1976. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

The objectives of the program reported are to provide a data base for the properties of materials used in the non-core construction of important components of the HTGR; to demonstrate the adequacy of the thermal barrier design in two critical areas: (1) fatigue life of attachment fixtures and (2) resiliency of insulation under vibration; and to investigate control and instrumentation systems associated with the safe operation of the HTGR. (auth)

27985 (GA-A-13793) FORT ST. VRAIN SURVEILLANCE AND TESTING PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 31 Jan 1976. Contract E(04-3)-167. 5p. Dep. NTIS $4.00.

This publication continues the quarterly report series on Fort St. Vrain (FSV) Surveillance and Testing. The program will perform post-startup tests on FSV plant components and systems to increase our knowledge of operating characteristics of large HTGRs. (auth)

27986 (Juel-Conf-14, pp 41-53) CHARACTERISTIC FEATURES OF THE CORE DESIGN OF HIGH-TEMPERATURE REACTORS. Brandes, S.; Lohnert, G. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

10 figs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

Following a survey on the possible applications of the HTGR depending on the height of the gas exiting temperatures, the core design for both of the fuel element concepts "sphere" and "block" is dealt with. Aspects of multiple refueling and one-way fueling in the design for spherical fuel elements are discussed. (DE)

27987 (Juel-Conf-14, pp 117-132) LAYOUT OF FUEL ELEMENTS IN ACCORDANCE WITH THE REQUIREMENTS OF THE HTR SYSTEM. Mittenbuehler, A.; Roellig, K. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

5 figs.; 1 tab. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

Following a brief description of the basic construction of the fuel particles which form the elementary unit of fuel elements in all HTR's, the design of the fuel element rods, spheres, and blocks are discussed. The requirements necessary for the reactor are described. The most important aspects of the design are described in the sections on core-physical design, stress analysis, corrosion, fission product release and particle behavior. (DE)

27988 (Juel-Conf-14, pp 191-210) STATE AND TARGETS OF THE DEVELOPMENT OF FUEL ELEMENTS FOR HIGH-TEMPERATURE REACTORS. Balthesen, E.; Pfahls, O. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

14 figs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

The state and targets of the development of spherical and prismatic fuel elements are presented from a material technical view. The starting point is the coated fuel particle. The state achieved shows that the development potential of these fuel elements is by no means exhausted. (DE)

27989 (Juel-Conf-14, pp 271-279) THE HTR FUEL CYCLE-TECHNOLOGY AND STRATEGY. Tillessen, U.; Merz, E. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

3 figs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

Following an explanation of the fundamentals and techniques of recycling of bred fissionable materials, the fuel cycle steps transport of spent elements, reprocessing and refabrication for block elements are presented. (DE)

27990 (JUL-1197) MEASUREMENT OF FISSION GASES RELEASED BY HTR IRRADIATION SAMPLES IN THE BR 2 REACTOR (MOL/BELGIUM). Koetter, H.; Mueller, H. B. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Brennelement- und Bestrahlungstechnologie). Apr 1975. 14p. (In German). INIS.

9 figs.; 2 tabs.; 5 refs.

During the irradiation of HTR-test fuel the release rate of fission gases is measured automatically. For that purpose the γ-spectrum of the sweep gas is analyzed with respect to the isotopes Xe-133, Xe-135, Xe-135^m, Xe-137, Xe-138, Kr-85^m, Kr-87, Kr-88, Kr-89. Gas sampling, spectral analysis, data handling and evaluation are controlled by computer. (DE)

27991 (JUL-1198) NUMERICAL INVESTIGATIONS FOR A NEW REFUELING SCHEME FOR HTR WITH PRISMATIC FUEL ELEMENTS UNDER OPERATING CONDITIONS OF A HELIUM TURBINE-POWER PLANT. Biele, B. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Projekt Hochtemperaturreaktor mit Heliumturbinen; Technische Hochschule Aachen (F. R. Germany)). Jun 1975. 81p. (In German). INIS.

45 figs.; 38 tabs.; 29 refs.

The effort to get highest gas exit temperatures in connection with lowest fuel element temperatures in a high temperature gas-cooled reactor with prismatic fuel elements (HTGR) asks for a special refueling scheme. The "Axial Pushthrough" is such a

refueling scheme. The neutronphysical and thermodynamic properties of a HTGR-core with Pushthrough-fuel-management is investigated. It is shown that a core with a high heavy metal content and pressed fuel elements (Monolith) with the geometry of the Fort St. Vrain fuel elements has the most favorable properties. (DE)

27992 (JUL-1201) ENGINEERING SOLUTIONS FOR A REFLECTOR CHANGE CONCEPT IN THE HIGH-TEMPERATURE REACTOR WITH PEBBLE BED CORE AND OTTO-FUELING. Kasper, K. J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nukleare Sicherheitsforschung; Technische Hochschule Aachen (F. R. Germany)). Jun 1975. 146p. (In German). INIS.

59 figs.; 12 tabs.; 90 refs.

In the field of reactor engineering an increasing tendency is visible towards a "repairable reactor". In the construction of the HTR with spherical fuel elements this fact should already be taken into account at an early stage. Additionally it is possible that in connection with the OTTO-fueling load conditions for the graphite reflector could result which are locally not far away from limiting values. Therefore the removability of the reflector is included in the reactor construction as an accompanying technical step of the physical lay-out of the core. The core arrangements are discussed as well as the properties of the graphites used and the operating conditions in the reactors are stated. Proposals are offered for the construction of a removable side and top reflector for a pebble bed reactor. Hereby a solution was found which allows the changing of the reflector and requires no significant increase of the costs for the reactor assembly. Moreover the requirements of reactor operation and of repairability are satisfied in an optimal manner.

27993 (JUL-1215) THE ZERO ENERGY EXPERIMENT KAHTER FOR THE HIGH TEMPERATURE REACTOR. Construction and Experimental Results of Phase I with Homogeneous Pebble Bed. Krings, F. J.; Drueke, V.; Jonas, H.; Kirch, N.; Neef, R. D.; Rueckert, M. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jul 1975. 41p. (In German). INIS.

56 figs.; 7 tabs.; 16 refs.

The critical pebble bed experiment KAHTER and the aim of the experiment are described. The experiments of phase I and their results are discussed. For comparison with calculations, critical masses, reactivity-worths of absorber rods and reaction rates are measured. The influence of backscattering from the walls and a change of the filling factor of the pebble bed on the critical mass are investigated. Reactivity-worths of absorbers are determined by means of the inhour-method, subcritical multiplication, pulsed source measurements and the inverse kinetic method. These methods are compared. Special attention is paid to the dependence of the detector position. Reaction rates are measured in the thermal, epithermal and fast energy region. (DE)

27994 (JUL-1226) IMPROVEMENT IN RETENTION OF SOLID FISSION PRODUCTS IN HTGR FUEL PARTICLES BY CERAMIC KERNEL ADDITIVES. Foerthmann, R.; Groos, E.; Gruebmeier, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). Aug 1975. 29p. INIS.

Increased requirements concerning the retention of long-lived solid fission products in fuel elements for use in advanced High Temperature Gas-cooled Reactors led to the development of coated particles with improved fission product retention of the kernel, which represent an alternative to silicon carbide-coated fuel particles. Two irradiation experiments have shown that the release of strontium, barium, and cesium from pyrocarbon-coated particles can be reduced by orders of magnitude if the oxide kernel contains alumina-silica additives. It was detected by electron microprobe analysis that the improved retention of the fission products in the fuel kernel is caused by formation of the stable aluminosilicates $SrAl_2Si_2O_8$, $BaAl_2Si_2O_8$ and $CsAlSi_2O_6$ in the additional aluminasilica phase of the kernel. (DE)

27995 N REACTOR STEAM GENERATOR PERFORMANCE. Carlson, P. A.; Kratzer, W. K. (United Nuclear Industries, Richland, WA). Nucl. Technol.; 28: No. 3, 383-387 (Mar 1976).

The N Reactor is equipped with 12 horizontal U-tube steam generators. Originally, these contained Type 304 stainless-steel tubes. From 1964 through 1971, ten were retubed with Inconel-600 tubes because severe stress corrosion cracking was experienced in stainless-steel tubes. Tube performance is monitored by eddy-current examinations, tube removals for destructive examination, and checking for radioactivity in the secondary system. The results of this program show that no significant corrosion has occurred in the Inconel-600 tubes in 11 yr of service. Five tube leaks have occurred in the two remaining units with Type 304 stainless-steel tubes over the same period. (auth)

27996 EFFECTS OF SERVICE ENVIRONMENTS ON THE BEHAVIOR OF HIGH-TEMPERATURE GAS-COOLED REACTOR STEAM GENERATOR STRUCTURAL MATERIALS. Mazandarany, F. N. (General Atomic Co., San Diego, CA); Rittenhouse, P. L. Nucl. Technol.; 28: No. 3, 406-423 (Mar 1976).

The literature pertinent to the steam and water corrosion of high-temperature gas-cooled reactor (HTGR) steam generator materials was reviewed and used to corroborate the expected excellent performance of Incoloy 800 and 2¼ Cr-1 Mo steel. Similarly, available information on HTGR primary coolant-metal compatibility (helium corrosion) was assessed in relation to results obtained in ongoing programs. Quantitative results from these programs were interpreted in terms of a qualitative mechanistic model. (auth)

27997 BEHAVIOR OF METALS IN HIGH-TEMPERATURE REACTOR HELIUM FOR STEAM GENERATORS. Bates, H.G.A.; Betteridge, W.; Cook, R. H.; Graham, L. W.; Lupton, D. F. (United Kingdom Atomic Energy Establishment, Winfrith, Eng.). Nucl. Technol.; 28: No. 3, 424-440 (Mar 1976).

To evaluate performance of materials in a high-temperature reactor, Dragon Project has conducted creep/corrosion tests in air and in impure helium on a wide range of structural and experimental steels and high-temperature alloys. These included 11 casts of austenitic steels tested in helium with controlled impurity levels. Tests were conducted at 650 to 800°C for times up to 15,000 h. Results are described. (auth)

27998 DESIGN AND MANUFACTURING EXPERIENCE FOR THE GERMAN THORIUM HIGH-TEMPERATURE REACTOR 300-MW(e) STEAM GENERATOR. Fricker, H. W. (Sulzer Brothers Ltd., Winterthur, Switzerland). Nucl. Technol.; 28: No. 3, 339-347 (Mar 1976).

The six identical steam generator units for the 300-MW(e) Thorium High-Temperature Reactor in Germany deliver both main and reheat steam at conditions similar to fossil-fired plants. Typical design characteristics are the once-through principle and the helical tube arrangement. Combining this with downhill boiling results in a simple design. Materials have been selected considering operation, fabrication, and conformity with codes of different countries. Some special manufacturing operations are the automated welding techniques, coiling and bending, forging, and the extensive quality control effort. The techniques developed can be applied to future plants without excessive modifications.

27999 HIGH-TEMPERATURE GAS-COOLED REACTOR STEAM GENERATOR DESIGN. Schuetzendeubel, W. G. (General Atomic Co., San Diego, CA). Nucl. Technol.; 28: No. 3, 315-327 (Mar 1976).

A prestressed concrete reactor vessel (PCRV) was used in the design of the 330-MW(e) Fort St. Vrain power demonstration plant. Use of the PCRV made the integration of all the nuclear steam supply system components practical. The primary coolant inventory was reduced and external piping and steam generator pressure shells were eliminated. A once-through-type steam generator system was selected. Materials selected for use in the pressure parts exceeded American Society of Mechanical Engineers Code requirements. The next step in the development of HTGR technology is the large commercial HTGR plant, which has once-through-type steam generators with a nominal capacity of 500 MW(th). Materials used in the main steam section range from 2¼ Cr-1 Mo to Ni-Fe-Cr (Alloy 800). High carbon levels were used to increase the creep strength of the materials. Gas cooling for fast breeder reactors is being studied by designing a 300-MW(e) demonstration plant. The steam generators are similar to the design of the Fort St. Vrain and large commercial plants. Tubes made of Alloy 800 are used. (auth)

28000 MODEL TESTS FOR PRESTRESSED CONCRETE PRESSURE VESSELS. Stoever, R. (Bochum Univ. (F. R. Germany). Inst. fuer Konstruktiven Ingenieurbau). Konstr. Ingenieurbau Ber.; No. 23, 60-69 (1975). (In German). (AED-CONF-75-491-006).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 16 figs.; 5 refs.

Investigations with models of reactor pressure vessels are used to check results of three dimensional calculation methods and to predict the behavior of the prototype. Model tests with 1:50 elastic pressure vessel models and with a 1:5 prestressed concrete pressure vessel are described and experimental results are presented. (DE)

28001 THE HIGH TEMPERATURE REACTOR LINE. State and Prospects. Mattick, W. (Brown, Boveri, und Cie A.G.,

Mannheim (F. R. Germany)); Bugl, J. (Brown, Boveri und Cie A. G., Mannheim (F. R. Germany). Stabsabteilung Kerntechnik). Atomwirtsch., Atomtech.; 20: No. 10, 483–489(Oct 1975). (In German).

From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975). 4 figs.; 2 tabs.

The test plants of the HTR line have fully confirmed the operational feasibility of the high temperature reactor. Design and construction of the prototype plants have made constant progress without suffering any technical setbacks; but the expenditure involved has continued to rise as a result of more and more stringent requirements. The criteria to be met by advanced HTR's have been defined over the past few years and extensive experimental studies designed to confirm the theoretical concepts have been carried out with good results so far. The solution to be found for the fuel cycle has been defined by successful preliminary work; as a consequence, completing the fuel cycle has mainly become an economic problem. An important contribution to its commercial breakthrough can be made by international cooperation. (DE)

28002 HIGH TEMPERATURE GAS-COOLED REACTORS — PERSPECTIVE OF THERMAL REACTOR CONCEPT WITH HIGH THERMAL EFFICIENCY. Pre-Report on the Subject of Technical Meeting No. 2. Kraemer, H.; Schlenker, H. V. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Kerntechnik; 17: No. 9/10, 399–403(Sep 1975). (In German, English).

The present HTR development is based worldwide on the extensive experience gained in the construction and operation of gas-cooled reactors of the Magnox type and on the successful operation of the experimental high temperature reactors Dragon, Peach Bottom and AVR. The advanced CO_2-cooled reactors, as well as the HTR prototype power plants for St. Vrain and THTR, are all suffering considerable delays in construction and commissioning. The commercial HTR plants have not yet achieved the decisive breakthrough onto the market. Increasing interest is being shown in advanced HTR systems, i.e., HTR with gas turbine, HTR process heat reactors and gas-cooled fast breeders. The key problem in the coming years will be the closing of the fuel cycle. Development work in this connection has already started. (DE)

28003 TREATMENT OF BIG CAVITIES IN DIFFUSION CALCULATIONS BY MONTE CARLO RESPONSE MATRICES. Bernat, W.; Klumpp, W.; Holder, P. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 153–157(1975).

Neutron streaming through the cylindrical cavity between core and upper reflector in a HTR pebble-bed reactor is treated by means of transport theory, while neutron diffusion in core and reflector is calculated by a modified two-dimensional diffusion code in (r,z) geometry. The coupling between transport region and diffusion region is completed by appropriate response matrices calculated by either a Monte Carlo method or using an analytic formalism. Application of this method and comparison with the corresponding $S_{(N)}$ calculation for the neutron flux distribution and reactivity of a model reactor with one central absorber rod in the cavity are presented. (DE)

28004 WORK IN THE FIELD OF GAS-COOLED GRAPHITE-MODERATED HIGH-TEMPERATURE REACTORS IN THE USA. Review. Arch. Energiewirtsch.; 29: No. 8, 804–811(Aug 1975). (In German).

The major technical data and characteristics of the two units of the Fulton nuclear power station, which are currently in the planning stage, are given in a summary. (DE)

28005 SPECIAL PROBLEMS OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS (PCRV) AND THEIR COMPONENTS. Schnellenbach, G. (Bochum Univ. (F. R. Germany). Abt. fuer Bauingenieurwesen). Konstr. Ingenieurbau Ber.; No. 23, 17-24(1975). (In German). (AED-CONF-75-491-002).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975).

Prestressed concrete reactor pressure vessels consist of prestressed concrete bodies as structural elements, and components such as liner, liner cooling system, and thermal shield. Only a composite action of these different elements makes the use of prestressed concrete for PCRV's possible. The individual elements are subjected to extreme loads and special conditions, and have to satisfy stringent reliability requirements. (DE)

28006 EXPERIENCE WITH AUTOMATION IN THE NUCLEAR POWER PLANT AT BELOYARSK. Komarov, A. N.; Artemov, A. S. Arch. Energiewirtsch.; 29: No. 7, 715–720(Jul 1975). (In German).

2 figs.; 1 ref. Also published in Ehlektr. Stn. v. 46(3), (1975) p. 39–41.

Based on the operational experience with the control equipment in both blocks of the nuclear power plant Beloyarsk, the most important functions and constructive details of the controls are discussed. Originally, 36 controls were planned for block 1 and 59 controls for block 2. The changes arising from the operation are discussed. (DE)

28007 STATUS OF HTR DIRECT CYCLE DEVELOPMENT. HHT STATUS REPORT OF 2nd JUNE 1975, AT JUELICH. Schlenker, H. V. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Projekt Hochtemperaturreaktor mit Heliumturbinen). Atomwirtsch., Atomtech.; 20: No. 10, 537–538(Oct 1975). (In German).

A status report for the first phase of the project high-temperature reactor with helium turbine of large power (HHT) is presented. The aim of phase I was to prove the feasibility of HHT plants which achieve a high degree of efficiency in the generation of electricity using dry cooling towers by making full use of the temperature potential of the HTR and should be less expensive than HTR dual-cycle systems due to a simpler construction. Phase II planned until 1979 should now lead to a 1080 MW(e) demonstration plant instead of a 300 MW(e) prototype. (DE)

28008 THE USE OF MODELS TO ESTIMATE THE PERFORMANCE OF BOILERS FOR GAS COOLED REACTORS. Bauly, J. A. (Clarke Chapman – John Thompson Ltd., Gateshead (UK)). pp 79–101 of Heat Exchangers. 9. International Meeting, Paris, 16–18 June 1971. Veron, M. (ed.). Paris, France; Institut Fraricais des Combustibles et de l'Energie (1974).

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

The use of experiments on models to give vital data for the design of boilers for gas cooled reactors is discussed. The use of helium as a heat transport gas is now being introduced and this has particularly required a reassessment of the modelling methods for gas side heat transfer and pressure loss. New work on the intermixing of the gas flow due to turbulent motion is discussed and results of theoretical and experimental studies are given. This work is relevant to the generation of maldistributions in the gas temperature profiles. For gas flow excited vibration new data is given for Strouhal numbers for tube matrices. Modelling for various water side behaviors, and structural modelling are also briefly discussed. (FR)

28009 TEN YEARS SYNTHESIS OF HEAT EXCHANGERS TESTING. List of Controlled Performances. Fremaux, L.; Korek, L.; Llory, M. (Electricite de France, 78 – Chatou. Dept. Transferts Thermiques et Thermodynamique). pp 475–491 of Heat Exchangers. 9. International Meeting, Paris, 16–18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974). (In French).

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

Electricite de France has developed in Saint-Denis large scale testing rigs for the components of magnox-type power stations. The loop number 2, heated by Joule effect with 30,000 kW has made possible the full-scale testing of nuclear heat exchanger prototype. After briefly describing the operating conditions and the measurement systems, the main results obtained during the test of the steam generator units are given for the magnox-type power station and for the heavy water moderated-gas cooled Monts-d'Arree power stations. (FR)

28010 SIMULATION OF A BOILER IN TRANSIENT OPERATING CONDITIONS ON A DIGITAL COMPUTER. Micheau, P.; Dahan, G.; Naudin, P. (Societe Bertin et Compagnie, 78 – Plaisir (France)). pp 143–158 of Heat Exchangers. 9. International Meeting, Paris, 16–18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974). (In French).

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

The mathematical model of the boiler of a nuclear power plant was determined for transient and steady state operating conditions. This gas-water heat exchanger is of counter-flow type. The boundary conditions considered for the fluids are: pressure, mass-flow, temperature at the inlet, and pressure at the outlet. The two passes, gas and water, are assumed to be monodimensional, and the separating wall to be so thin that it is not necessary to take into account the temperature drop across it. In the energy equation for the gas, the terms of pressure with respect to position were neglected and also the terms of kinetic energy. The following assumptions were considered for the water pass: the pressure is uniform throughout the boiler, the shear stress at the interface between liquid and vapor is negligible, throughout the boiling zone, the heat exchange coefficient is uniform. The set of equations which forms the model has been resolved by a discretization method. The characteristic magnitudes for the fluids were defined at the boundaries of the meshes, the temperatures of the wall are those in the center of the meshes. At any time, the model

allows the determination of the characteristic magnitudes of the two fluids and the walls, starting from the boundary conditions which vary with time, in a finite number of points. On the gas side, the velocities may cancel themselves and change direction. On the water steam side, the flow must have a unique direction. Satisfying results concerning some operating conditions have been obtained. (FR)

28011 HELIUM LEAK TESTING OF THE HEAT EXCHANGERS OF THE BUGEY-1 NUCLEAR POWER PLANT. Lhermitte, M. R. (Electricite de France, 75 – Paris, Service de la Production Thermique); Chiret, M. (Societe Babcock-Atlantique, 75 - Paris (France)). pp 70-83 of Meeting on Leak Detection and Helium-Tightness Tests. May 16, 1972. Proceedings. Paris, France; Comite Francais d'Etude des Essais Non Destructifs ([nd]). (In French).

From meeting on leak detection and helium-tightness tests; Paris, France (16 May 1972). Special edition of Revue de Metallurgie and Soudage et Techniques connexes.

The Bugey-1 heat exchanger is described and the helium leak testing method used outlined. It is applied to leak detection on the panels and groups of exchangers in the manufacture plant and on the site. The special case of an intermittent leak is discussed. (FR)

28012 A DEVICE FOR THERMALLY INSULATING A CONCRETE WALL COVERED WITH A THERMAL PLATE. Cornille, Y.; Felten, P. (to CEA, 75 – Paris (France)). French Patent 2,229,014/A/. 9 May 1973. 7p. (In French).

The device is characterized in that it comprises a stack of bricks of parallelepipedic shape of cellular silica, bound to one another and to a metal plate by means of a silica-mortar layer and of anchoring keys welded to the metal plate, at one end thereof, and embedded in at least two juxtaposed bricks, at the other end thereof. This can be used for insulating the cavity located under the core of a high temperature reactor. (FR)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 26812 and 28009.

28013 (INIS-mf-1873) OECD HALDEN REACTOR PROJECT. 14TH ANNUAL REPORT 1973. (Nuclear Energy Agency, 75 - Paris (France)). 1973. 105p. INIS.

The main events and achievements of the OECD Halden Reactor Project during 1973 are summarized. The period under review represents the first year of the fifth Halden Agreement. Efforts of the Halden Programme Group and Project staff have resulted in several direct cooperations on development projects between the Project and organizations in member countries. The main items reported upon are control methods and computer applications in large power reactors; fuel research and test fuel irradiation (with studies relating to fuel/cladding interaction phenomena, cladding material behavior, fission product release, and fuel densification phenomena); reactor operation; administration and finances.

28014 MATERIALS IN CANDU STEAM GENERATORS FROM THE DESIGNER'S POINT OF VIEW. Vandeth, S. (Atomic Energy of Canada Ltd., Mississauga, Ont.); Hemmings, R. L. Nucl. Technol.; 28: No. 3, 328-338(Mar 1976).

The Canada Deuterium Uranium (CANDU) pressurized heavy water (PHW) reactor is a pressure tube reactor moderated with heavy water and cooled with either light or heavy water. Materials used in the steam generators are chosen to be compatible with the CANDU system by considering reliability, activation of corrosion products, cost, manufacturing considerations, operating requirements, availability of materials, and material integrity. Tubing materials are chosen to provide resistance to corrosion and erosion in a controlled chemical environment on both sides of the tubes thus ensuring a low probability of leakage. Thus certain aspects of the feedwater system must be considered, such as avoiding copper alloys, ensuring integrity of the turbine condenser, and specifying feedwater chemistry. The steam generators in recently committed stations use Incoloy-800 tubing with a restrictive composition. Monel-400 and Inconel-600 have been used in earlier stations. The steam generators are fabricated entirely of carbon steel except for the tubing and tubesheet overlay. Materials are selected cooperatively by the steam generator manufacturer and Atomic Energy of Canada Limited (AECL). Material quality, especially tubing, is obtained through stringent specifications and quality control. AECL maintains a current expertise and also maintains research into potential improvements primarily associated with testing of alternative tube alloys and water chemistry effects on these alloys. (auth)

Power Reactors, Breeding

Refer also to abstracts 26095, 26612, 26751, 26752, 26761–26763, 26767, 26813, 27941, 28114, 28116, 28117, 28134, 28135, 28141, 28155, and 28156.

28015 (ANL-8112) THI3D: A COMPUTER PROGRAM FOR STEADY-STATE THERMAL-HYDRAULIC MULTICHANNEL ANALYSIS. Sha, W. T.; Schmitt, R. C. (Argonne National Lab., Ill. (USA)). Dec 1975. Contract W-31-109-Eng-38. 119p. AT.

A new computational model for steady-state, single-phase, thermal-hydraulic multichannel analysis is presented. The model accounts for conservation of mass, energy, and momentum subject to pressure-drop boundary conditions and leads to a nonlinear multipoint boundary-value problem. Turbulent interchange, radial thermal conduction, and forced flow due to the wire wrap or grid between channels are explicitly taken into account. Temperature distributions in the coolant, cladding, fuel, and duct wall and the size of the central void of the oxide fuel after thermal restructuring are computed. Three different thermal-hydraulic channel arrangements (square, hexagonal, and triangular) can be treated by the method presented here. Multipin analysis with transverse interactions, or multiassembly calculations without transverse interactions between the channels, can be performed. The most important feature of the model is that problems in partial flow blockage can be analyzed, and the effect on the redistribution of the inlet mass velocity can be taken into account. (auth)

28016 (ANL-CT-75-23) STUDY ON THE NODAL APPROXIMATION OF THE CRBR CORE SIMULATION. Saphier, D.; Kirsch, L. W.; Mulcahey, T. P. (Argonne National Lab., Ill. (USA)). Jan 1975. Contract W-31-109-Eng-38. 31p. AT.

The WARD Rev model for simulating the CRBR core has been revised. Errors have been corrected and the nodal approximation expanded to include up to 25 instead of the fixed 5 nodes in the WARD model. A detailed description of the upper axial blanket—10 axial and 4 radial nodes—instead of the lumped parameter model, has also been inserted in the new program. The simulation has been used to obtain detailed transient temperature distribution initiated by a pump trip and followed in 2.2 sec by a power trip. Comparative calculations with 25 and 5 nodes gave essentially the same result for the hot spot temperature and the hot spot location. It was concluded that the nodal approximation used by WARD for the present WARD model is sufficient to describe the transient of the hot spot temperature and its location.

28017 (ANL-CT-76-26) FLOW-INDUCED VIBRATION SCALE MODEL TEST OF THE CRBR INSTRUMENT POST. Mulcahy, T. M.; Yeh, T. T.; Lawrence, W. (Argonne National Lab., Ill. (USA)). Feb 1976. 35p. AT.

A one-third scale model of the CRBR Instrument Post was designed, fabricated, and bench tested to determine whether impinging flow from fuel assembly exit nozzles would induce significant vibrations. Distortions made in scaling are discussed. Typical reactor operating conditions were included in the rest parameters: flow rates, flow distributions, and vertical gaps, lateral misalignments, and rotational misalignments between the bottom of the I/P and the top of the fuel assembly nozzle. Shaker testing showed the lowest bending and torsional frequencies had been simulated with less than 2 percent damping, and the model had been isolated from test system frequencies. Flow testing indicated the response of the I/P model was due to random pressure fluctuations, with no fluid elastic excitation occurring. While variations in the response with different test parameters did occur, in general, the response was very small.

28018 (ANL-Trans-1046) CALCULATIONS BY MONTE-CARLO METHOD IN THREE DIMENSIONS (TRIPOLI CODE) OF NEUTRON SPECTRUM IN THE LOWER SHIELDS OF THE PHENIX. Nimal, J. C.; Vergnaud, T. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1970. Translation of CEA-N-1359. 38p. Dep. NTIS $4.00.

The results of computations done with the help of the TRIPOLI code for the lower part of the Phenix reactor are presented. These computations are a preliminary step in the calculation trying to determine the activation of the secondary sodium. The case treated is in two dimensions and includes strong attenuation of the neutron flux. The results are compared with computations done in spherical geometry with the help of the NIOBE code.

28019 (ANL-Trans-1047) BREAKTHROUGH OF FAST BREEDER REACTORS IN FRANCE. Denielou, G. Translated from Rev. Fr. Electr.; 45: No. 238, 10-17(1972). 14p. Dep. NTIS $3.50.

The development of the French fast breeder reactor program is reviewed. (JWR)

28020 (CONF-760314-1) STUDIES IN NONDESTRUCTIVE TESTING WITH POTENTIAL FOR IN-SERVICE INSPECTION OF LMFBRs. McClung, R. W. (Oak Ridge National Lab., Tenn. (USA)). 1976. 13p. Dep. NTIS $3.50.

From meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

A variety of nondestructive examination techniques have been and are being developed at ORNL with potential for ISI in LMFBRs. Among these are radiographic techniques for radiation environment and image enhancement, advanced eddy-current techniques and equipment for flaw detection and thickness measurement and ISI of steam generator tubing, and ultrasonic methods for quantitative flaw evaluation using frequency-analysis and bore-side ultrasonic techniques for steam generator tubing. Further developments should result in positive application to ISI.

28021 (ERDA-68) LIQUID METAL FAST BREEDER REACTOR PROGRAM (LMFBR): FACILITY PROFILES. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development; Argonne National Lab., Ill. (USA)). Dec 1975. 288p. Dep. NTIS $9.25.

A description is presented of the experimental test facilities involved in the conduct of the LMFBR research and development program. Existing facilities and those under construction or authorized as of October 1975 are described. Each profile presents brief descriptions of the overall facility and its test area and data relating to its experimental and testing capability. Introductory material for each section includes site and facility maps and an alphabetical list of the profiles contained in the section. A glossary of acronyms and letter designations in common usage to describe organizations, reactor and test facilities, components, etc. involved in the LMFBR program is included. Alphabetical, organizational, and programmatic indexes are provided as a convenient method of identifying the facilities with their locations and with their principal uses in the LMFBR program.

28022 (GA-A-13766) GAS-COOLED FAST BREEDER REACTOR. Quarterly Progress Report, August 1, 1975–October 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 5 Jan 1976. Contract E(04-3)-167. 196p. Dep. NTIS $7.60.

The tasks of the Gas-Cooled Fast Breeder Reactor (GCFR) program that are supported by the U. S. Energy Research and Development Administration include: development of GCFR fuel, blanket, and control elements; development of the pressure equilization system for GCFR fuel; an out-of-pile loop facility test program plan; fuels and materials development; fuel-, blanket- and control-rod analyses and development; nuclear analysis and reactor physics for GCFR core design; shielding requirements for the GCFR; reactor engineering to assess the thermal, hydraulic and structural performance of the core and core support structure; development of reactor components including the reactor vessel, control and locking mechanisms, fuel-handling equipment, core support structure, shielding assemblies, main helium circulator, steam generator, and auxiliary circulator; the development of a helium circulator test facility; and reactor safety, including an in-pile safety evaluation program. (auth)

28023 (HEDL-SA-929A) RECENT DEVELOPMENTS IN THE ANALYSIS OF COOLANT SODIUM FOR FAST BREEDER REACTORS. Keough, R. F.; McCown, J. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1976. 21p. (CONF-750806-6). Dep. NTIS $3.50.

From 170th American Chemical Society national meeting; Chicago, Illinois, USA (24 Aug 1975).

The measurement of impurities in sodium is an important part of the sodium technology for the fast breeder reactor program. A knowledge of impurity levels in sodium provides an important source of information on such things as corrosion rates, air and water leak location and detection, and the effectiveness of the sodium purification systems. A discussion is presented of some of the analytical techniques for sodium characterization in reactor heat transfer systems. Emphasis is placed on some recently developed alternatives to laboratory analysis.

28024 (HEDL-TC-327) WATER VAPOR NITROGEN PROCESS FOR SODIUM REMOVAL. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-2170. 109p. AT.

The objective of this document is to present the data, information and conclusions resulting from the Water Vapor Nitrogen Process development program and to provide a basis for sodium removal process selection for LMFBR facilities. The report focuses on information needed to evaluate the technical acceptability of the process, omitting issues of economics, safety, licensability, and compatibility with other plant systems. To accomplish this, the report discusses: (1) characteristics of the Water Vapor Nitrogen Process (WVN), (2) possible conditions for stress corrosion cracking related to the process, (3) process control parameters and implementation, and (4) applicable process scale-up experience. (auth)

28025 (IAEA–169(Vol.3), pp 3 v.; v.3 p. 43-51) PHYSICAL PECULIARITIES OF THE FAST POWER REACTOR FUEL CYCLE. Orlov, V. V.; Bakumenko, O. D.; Ikhlov, E. M.; Kulakovskij, M. Ya.; Troyanov, M. F.; Tsykunov, A. G. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The following calculated physical characteristics of fast power reactor fuel are presented: isotopic composition, fission product activity, and residual heat release. Changes of these characteristics with the cooling time of the spent fuel are analyzed, as well as the influence of these values on the problem of fuel transportation and the required degree of fuel decontamination from fission products. Factors affecting radiation conditions in the process of fabrication of fuel elements and assemblies are considered.

28026 (Juel-Conf–14, pp 55-65) KALKAR NUCLEAR POWER STATION. Koehler, M. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

8 figs.; 2 tabs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

A brief survey is given on the design of fuel elements: the sodium properties and the design of the heat transfer system, the reactor tank, the fuel element handling, and the organization and state of the project. (DE)

28027 (Juel-Conf–14, pp 67-79) THE CONCEPT OF THE 1,000 MWe HELIUM-COOLED FAST BREEDER REACTOR GSB. Goetzmann, C. A. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

10 figs.; 1 ref. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

The advantages and disadvantages of the gas breeder concept are discussed with special regard to the specific design data as well as to safety problems. (DE)

28028 (Juel-Conf–14, pp 133-146) FUEL ELEMENT LAYOUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE SNR SYSTEM. Mayer, H.; Spenke, H. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

8 figs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

Starting with the concept of rod-shaped fuel elements which are bundled in hexagonal cases, the technological and material technical boundary conditions as well as the operational requirements are described. A report is given on the state of the concept design and methodics in the SNR 300. Furthermore, the aspects of the fuel element to be considered in stepping from the prototype to the large plant as well as the safety technical repercussions on the fuel element concept are reported. (DE)

28029 (Juel-Conf–14, pp 147-159) FUEL ELEMENT LAYOUT IN ACCORDANCE WITH THE REQUIREMENTS OF GSB SYSTEMS. Jung, W.; Krug, W. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

5 figs.; 2 tabs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

The concept of the pressure suppressing rod cluster fuel element is dealt with which has been designed along the lines of the FBR development. The pressure compensating system and heat technical design are described. (DE)

28030 (Juel-Conf–14, pp 211-224) STATUS AND FURTHER DEVELOPMENT TARGETS OF THE SNR FUEL ELEMENT DEVELOPMENT. Karsten, G. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

13 figs.; 8 refs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

Within the scope of the fuel element development program for the fast breeder reactor SNR 300, 500 fuel pins have been irradiated since 1964, 250 of them in a fast flux. The result is that the maximum nominal target burnup of 90,000 MWd/t of the SNR 300 Mk Ia possibly can be reached. The main problems which arise from the clad swelling and internal corrosion can be met by special pretreatments of the austenitic stainless steel 1.4970 and a fuel stoichiometry of 1.97. Beyond this target either material property improvements have to be made or burnup reductions have to be accepted. These remaining questions can be answered by the use of the SNR 300 as a test reactor. A further target is the development of a carbide fuel element. This will be very effective in a high power breeder reactor because of its low fissile inventory and high breeding gain under the aspects of saving uranium resources in the future. This development program will also be finalized in the SNR 300. (DE)

28031 (Juel-Conf-14, pp 225-242) STATE AND FURTHER AIMS OF THE DEVELOPMENT OF GSB FUEL ELEMENTS. Stehle, H.; Krawczynski, S. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

13 figs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

Following a survey on the main points of development, a report is given on the state of the technological development as well as on the state of the irradiation tests with the single rod and in the loop experiment Mol. The fuel element development is very much adapted to that of the sodium breeder fuel element. (DE)

28032 (Juel-Conf-14, pp 281-293) THE CLOSING OF THE SNR FUEL CYCLE. Ochsenfeld, W.; Schroeder, R. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements on LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

1 fig.; 4 tabs.; 9 refs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

Following a presentation of strategic considerations on reprocessing, the most important problems and their solutions in the technology of reprocessing of SNR fuel are described. (DE)

28033 (Juel-Conf-14, pp 295-311) THE CLOSING OF THE FUEL CYCLE-TECHNOLOGY AND STRATEGY-OF THE GSB. Meyer, L. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

10 figs.; 3 tabs.; 11 refs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

The tasks of the breeder reactors in the future nuclear fuel economy are described. The details of the gas breeder (e.g., high breeding ratio) give a particular value to U 233 which affects the composition of a future energy system of breeders and thermal converters. (DE)

28034 (KFK-2211) MEASUREMENT OF THE ENERGY DISTRIBUTION OF THE GAMMA FIELD IN A FAST REACTOR. Korn, H. E. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Nov 1975. 78p. (In German). Dep. NTIS (US Sales Only) $5.00.

Si(Li) semiconductor detectors were used to measure the energy distribution of the gamma field in the fast zero-power facility Karlsruhe SNEAK with the help of compton electron spectrum registered with the detectors. The method was checked by comparing measured γ-attenuation coefficients of different materials with the values known from literature. The spectra of two assemblies (one with uranium, the other with plutonium fuel) with compositions similar to fast sodium cooled breeder reactors were measured in the core and in the blanket. In addition the γ-spectrum in a lithium sphere induced by 14 MeV neutrons was determined. (auth)

28035 (LMEC-TDR-75-13) TESTING OF THE KAMAN PROTOTYPE LEVEL TRANSDUCER. Fischer, B. E. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 1975. Contract E(04-3)-700. 45p. AT.

Results are described of the test program conducted at the Liquid Metal Engineering Center (LMEC) to determine the performance of a prototype level measuring system supplied by Kaman Sciences Corporation. Sodium testing included calibrations from 300 to 1200°F. The test program was conducted over a period of approximately two months.

28036 (ORNL-5078) MOLTEN-SALT REACTOR PROGRAM. Semiannual Progress Report for Period Ending August 31, 1975. McNeese, L. E. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 170p. Dep. NTIS $8.50.

Separate abstracts were prepared for sections on MSBR design and development, chemistry, materials development, fuel reprocessing, and salt production. (JWR)

For abstracts of individual sections see: 25412, 25450, 25559, 26612, and 28037.

28037 (ORNL-5078, pp 1-27) MSBR DESIGN AND DEVELOPMENT. Engel, J. R. Feb 1976.

In molten-salt reactor program, Semiannual progress report for period ending August 31, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Progress in MSBR design and development is reported under the following headings: tritium behavior, xenon behavior, neutronic analysis, high-temperature design methods, gas-systems technology facility, coolant-salt technology facility, and forced convection loops. (JWR)

28038 (ORNL-5101) NEUTRON PHYSICS DIVISION PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1975. Maienschein, F. C. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 122p. Dep. NTIS $7.00.

Included are 127 abstracts and summaries of papers and reports published or presented at scientific meetings during the reporting period, which extends from August 31, 1974 to October 31, 1975. The primary areas of study are the liquid-metal fast breeder reactor program, the gas cooled fast breeder reactor program, the controlled thermonuclear reactor program, the high-energy accelerator shielding program, and the defense nuclear agency program. (BJG)

28039 (RCN-237) APPARATUS FOR THERMAL TRANSIENT TUBE BURST TESTS ON LMFBR CLADDING MATERIAL. van Tilborg, P. J.; Stins, T. (Stichting Reactor Centrum Nederland, Petten). Oct 1975. 27p. Dep. NTIS (US Sales Only) $4.00.

A description is given of instrumentation for stress-rupture testing of tubes under internal gas-pressure loading in a vacuum environment. During a test a tube is heated by an electric current through its wall. This method allows very high test temperatures as well as rapid temperature variations during tests. When rapidly changing temperatures are required the temperature is controlled using a chromel and alumel thread spotwelded together on the outer surface of the tube wall.

28040 (RCN-239) FAST REACTOR PROGRAM. Combined Second and Third Quarters 1975 Progress Report. Hoekstra, E. K. (comp.). (Stichting Reactor Centrum Nederland, Petten). Nov 1975. 72p. Dep. NTIS (US Sales Only) $4.50.

Progress in evaluation and adjustment of fission product capture cross sections is illustrated by results of a ^{93}Nb cross section evaluation and ratios of adjusted and unadjusted group cross sections for ^{127}I and ^{93}Nb. Out-of-pile transient burst tests on tubes of fuel canning material and initial results of the loss-of-cooling experiment with fuel rod R63-L13 are discussed. The preparation of somewhat larger quantities of UC, UC-UN and U_2N_3 has begun. The creep strength of reactor vessel material DIN 1.4948 was found considerably affected after a short irradiation of 10^{22} n.m^{-2}; this was due to embrittlement. The mass concentration decay curves obtained during aerosol experiments in various vessels with a heated layer of water on the floor appear to be in reasonable agreement with the MADCA model. An application of laser doppler anemometry is being developed to measure the velocity distribution in a sub-channel of a fuel element. Preparations for the sodium boiling experiments in a blocked 28-rod bundle are under way.

28041 (RDT-E-4-5T(Rev.)(1-76)) FORCED-CIRCULATION COLD TRAP ASSEMBLY FOR REMOVAL OF SODIUM IMPURITIES. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Development and Demonstration). Jan 1976. 22p. RSO.

A standard is presented to delineate the requirements for the design, materials, fabrication, examination, acceptance testing,

and delivery of a cold trap assembly to remove impurities from liquid sodium by crystallization. (auth)

28042 MATERIALS DEVELOPMENT FOR ADVANCED REACTORS. Cunningham, G. W. (Energy Research and Development Administration, Washington, DC). Nucl. Technol.; 28: No. 3, 301-304(Mar 1976).

Materials development is needed in advanced reactor programs to improve economy and safety of nuclear system components, to provide data for advanced design methods needed for the severe operating conditions, and to nondestructively inspect components under poor accessibility. Interaction between alloy development, stress analysis, and component and system design guides the program on structural materials for core and secondary systems, including steam generators. Various austenitic, ferritic, and high-nickel alloys are being developed for different components. (auth)

28043 DESIGN OF THE CLINCH RIVER BREEDER REACTOR PLANT STEAM GENERATORS. Whipple, J. C.; Spalaris, C. N. (General Electric Co., Sunnyvale, CA). Nucl. Technol.; 28: No. 3, 305-314(Mar 1976).

Three steam generation systems are employed in the Clinch River Breeder Reactor Plant to produce electrical power for delivery to the Tennessee Valley Authority grid. Each steam generator system contains two parallel operating evaporators and one superheater. These vertical shell and tube heat exchangers are arranged in a hockey stick configuration and are identical in design except for inlet water orifice inserts added to the evaporators to ensure flow stability. Alloy 2¼ Cr–1 Mo was selected as the material of construction for the sodium-water boundary on the basis of its excellent resistance to water side stress corrosion and fabricability. Development programs are underway to confirm the ability of the steam generators to operate with departure from nucleate boiling, obtain necessary mechanical and physical properties for design, confirm corrosion and decarburization design allowances, and develop reliable fabrication and inservice inspection techniques. (auth)

28044 COMPATIBILITY OF Fe–2¼ WT PERCENT Cr–1 WT PERCENT Mo STEEL IN A SODIUM ENVIRONMENT. Natesan, K.; Chopra, O. K.; Kassner, T. F. (Argonne National Lab., IL). Nucl. Technol.; 28: No. 3, 441-451(Mar 1976).

Kinetics of decarburization of Fe–2¼ wt percent Cr–1 wt percent Mo steel in a sodium environment has been studied at temperatures between 480 and 650°C in the normalized and normalized-tempered conditions. Carbon concentration-distance profiles were obtained as a function of sodium exposure time and decarburization rate constants were evaluated. It was found that the heat treatment of the steel had no effect on the decarburization behavior at 650°C; however, at lower temperatures, the normalized steel was found to decarburize significantly faster than the steel in the normalized-tempered condition. Microstructural examinations of specimens exposed at 650°C revealed that M_6C was the stable carbide, and the transformation of $M_{23}C_6$ to M_6C was accelerated by the decarburization process. In specimens exposed at 480°C, the stable carbides were found to be M_7C_3, Fe_3C, and M_2C. The results also showed that the steel would decarburize to a certain carbon level that corresponds to a stable carbide structure at each temperature, and any additional decarburization will be controlled by the dissolution rate of the carbide phases in the ferrite matrix. (auth)

28045 CARBON TRANSFER BEHAVIOR OF MATERIALS FOR LIQUID-METAL FAST BREEDER REACTOR STEAM GENERATORS. Matsumoto, K. (Ishikawajima-Harima Heavy Industries Co., Ltd, Yokohama City, Japan); Ohta, Y.; Kataoka, T. Nucl. Technol.; 28: No. 3, 452-470(Mar 1976).

To examine the compatibility with liquid sodium possessed by structural materials for LMFBR steam generators, tests were conducted on selected steels in a sodium loop facility. The materials tested were ferritic 2¼ Cr–1 Mo, 2¼ Cr–1 Mo–1 Nb, high Cr–1 Mo, and austenitic AISI Type 316 stainless steels. A method is proposed for estimating the rate of decarburization of the specimen by integrating the distribution curves of the carbon content determined from emission spectroscopic analysis of layers underlying the surface, which are successively uncovered by precision grinding. The decarburization behavior was found to reflect differences in the heat treatment history of the specimen, carbon loss being found to be more rapid on annealed than on normalized and tempered steels. (auth)

28046 EFFECTS OF TEN YEARS EXPERIMENTAL BREEDER REACTOR II SERVICE ON 2¼ Cr–1 Mo STEEL. Shields, J. A. Jr.; Longua, K. J. (Argonne National Lab., Idaho Falls, ID). Nucl. Technol.; 28: No. 3, 471-481(Mar 1976).

A 5-ft segment of 2¼ Cr–1 Mo ferritic steel pipe has been removed from the Experimental Breeder Reactor II (EBR-II) steam for metallurgical evaluation after 90,000 h of service in the temperature range of 580 to 820°F. Optical metallography, instrumented impact testing, tensile testing, Auger electron spectroscopy, and scanning electron fractography have been performed to assess the capability of the material to perform its function in the future. Service in the EBR-II steam system has resulted in additional precipitation of fine uniformly dispersed carbides throughout the microstructure. As a result of these changes, room temperature yield and tensile strengths are reduced 23.3 and 4.5 percent, respectively. Excellent toughness is observed on the upper shelf of the Charpy V-notch impact energy curve. No evidence of embrittlement phenomena was observed. The results indicate that the 2¼ Cr–1 Mo steel employed in the EBR-II system has not suffered significant degradation in metallurgical properties and should perform well in the future. (auth)

28047 FRENCH STEAM GENERATOR EXPERIENCE: PHENIX AND BEYOND. Robin, M. G. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Technol.; 28: No. 3, 482-489(Mar 1976).

The Stein Industrie steam generator of the 250-MW(e) demonstration fast breeder reactor Phenix comprises three units. Each unit is divided into 12 evaporator modules, 12 superheater modules, and 12 reheater modules. Twenty-four evaporators are made of 2¼ Cr–1 Mo ferritic steel and 12 are made of 2¼ Cr–1 Mo–1 Nb stabilized ferritic steel. All superheaters and reheaters are made of 321 austenitic steel. Since Oct. 1973, this steam generator has been submitted to a number of startups and shutdowns and some 9000 h of operation at full load without any leak, with an acceptable hydrogen diffusion rate of 0.25 g/h per unit through the single wall of the tubes. The Fives-Cail Babcock steam generator selected for the 1200-MW(e) Fast Breeder Power Plant Super Phenix is comprised of four modules with a 357-tube helical bundle made of Alloy 800 housed in a shell made of an austenitic steel (Type 304 or 316L). The module is rated at 750 MW(th) and weighs 140 tons. Other steam generators made of ferritic steels are considered in the longer range for power plants beyond Super Phenix. (auth)

28048 MECHANICAL AND PHYSICAL PROPERTIES OF 2¼ Cr–1 Mo STEEL IN SUPPORT OF CLINCH RIVER BREEDER REACTOR PLANT STEAM GENERATOR DESIGN. Brinkman, C. R.; Williams, R. K.; Klueh, R. L.; Hebble, T. L. (Oak Ridge National Lab., TN). Nucl. Technol.; 28: No. 3, 490-505(Mar 1976).

Mechanical and physical property tests on annealed 2¼ Cr–1 Mo steel were conducted in an effort to define behavior in support of the design of the Clinch River Breeder Reactor Plant steam generator system. True-stress true-plastic strain tensile data between the 0.2 percent offset yield stress and the ultimate tensile strength for temperatures between 25 and 593°C and strain rates between 6.7×10^{-6} to 6.7×10^{-3}/sec were fit with an equation. Creep data were analyzed and an analytical expression formulated defining strain-time behavior for primary and secondary creep. Similarly, an expression was obtained defining the time to the onset of tertiary creep as a function of stress and temperature. Strain- and load-controlled fatigue data were analyzed and proposed. American Society of Mechanical Engineers (ASME) fatigue design curves were formulated for temperatures ranging from 25 to 593°C. Dynamic strain aging was found to lower the fatigue strength of this material at 371°C, and this was attributed to dynamic strain aging. Results of subcritical crack growth tests are also reported. Comparisons between thermal conductivity and diffusivity values and those found in the ASME Code indicated that the new values were significantly higher than those presently found in the Code. (auth)

28049 COMPARISON OF VARIOUS CHROMIUM–MOLYBDENUM LOW-ALLOY STEELS FOR LIQUID-METAL FAST BREEDER REACTOR STEAM GENERATORS. Yukitoshi, T.; Moroishi, T.; Koizumi, I.; Abe, T.; Yoshikawa, K.; Shida, Y. (Sumitomo Metal Industries, Ltd., Amagasaki, Japan). Nucl. Technol.; 28: No. 3, 506-515(Mar 1976).

High-temperature strength, weldability, and decarburization behavior in liquid sodium of 2¼ Cr–1 Mo steel with a wide variety of heat treatments and some carbon stabilized 2¼ Cr–1 Mo steels are examined for the purpose of material selection of LMFBR steam generator tubes. Decarburization of 2¼ Cr–Mo steel in sodium can be suppressed when it is appropriately normalized and tempered instead of annealed. The 2¼ Cr–1 Mo–Nb–Ni steel is considered to be preferable to other stabilized steels, since a small addition of nickel assures sufficient strength, even if the normalizing temperature is as low as 950°C. Stabilized steels should be welded carefully to obtain a fully penetrated bead. Preheating above 200°C and postheating

above 720°C are required for stabilization. Compared with all the investigated properties, the materials recommended for LMFBR steam generator tubes are normalized-tempered 2¼ Cr–1 Mo steel and, if decarburization is not allowable, 2¼ Cr–1 Mo–Nb–Ni steel, with the condition that a sound-welded joint can be available. (auth)

28050 U. S. ADVANCED MATERIALS DEVELOPMENT PROGRAM FOR STEAM GENERATORS. Patriarca, P. (Oak Ridge National Lab., TN); Harkness, S. D.; Duke, J. M.; Cooper, L. R. Nucl. Technol.; 28: No. 3, 516-536(Mar 1976).

Extensive knowledge and acceptability of pertinent properties, wide fabrication experience, and code acceptance have led to selection of 2¼ Cr–1 Mo steel for the Clinch River Breeder Reactor Plant steam generators. Limitations of this alloy indicate that further development of high-strength ferritic steels containing 9 to 12 percent chromium and the high-nickel Alloy 800 could lead to superior materials, and programs to develop these materials have started. Combustion Engineering has surveyed the experience with the high-strength ferritic steels and prepared ingots of 26 selected compositions. Charpy V-notch tests and metallography have been used to characterize these alloys, and optimum welding rod compositions for these alloys are under development. Westinghouse-Tampa is undertaking a program to gain code acceptance of Alloy 800. A program has been set up to provide the information required for design and fabrication of reliable components. Progress has been made on characterization, the role of tertiary creep in failure, and the development of welding processes. The Heppenstall Company is demonstrating its process for manufacturing large high-quality ingots. (auth)

28051 EUROPEAN BREEDERS (II): THE NUCLEAR PARTS ARE NOT THE PROBLEM. Science; 191: No. 4225, 368-372 (30 Jan 1976).

Some of the problems encountered concerning non-nuclear plant components in European breeder reactor prototypes are described. Steam generator problems in the British and Soviet breeder programs are discussed in particular.

28052 CLINCH RIVER BREEDER REACTOR ENVIRONMENTAL EFFECTS: GENERAL WATER-SIDE CORROSION. DeVan, J. H.; Griess, J. C. (Oak Ridge National Lab., TN). Nucl. Technol.; 28: No. 3, 398-405(Mar 1976).

Studies are described of the general corrosion of 2¼ Cr–1 Mo steel in pure superheated steam, in impure superheated and saturated steam, and under nucleate boiling conditions. The test parameters were selected to provide information relevant to the use of this steel for the Clinch River Breeder Reactor superheaters and evaporators. The oxidation rate of 2¼ Cr–1 Mo steel in superheated steam was measured under heat transfer conditions at 510 to 540°C (950 to 1005°F), and was approximately 1½ times that measured under isothermal conditions. Extensive general attack of stressed 2¼ Cr–1 Mo steel specimens occurred in cyclic tests in superheated and saturated steam with chloride and oxygen additions, although no cracking or localized attack was observed. Considerably less attack occurred under superheat conditions or in the absence of oxygen. Tests under nucleate boiling conditions were operated to evaluate crevice effects associated with porous films on heat transfer surfaces. Significant crevice corrosion was produced in water containing 10 ppm chloride; a heavier but more general attack occurred in treated cooling tower water. (auth)

28053 FABRICATION AND INSPECTION DEVELOPMENT FOR CLINCH RIVER BREEDER REACTOR PLANT STEAM GENERATORS. McClung, R. W. (Oak Ridge National Lab., TN); Slaughter, G. M.; Spalaris, C. N.; Lillie, A. F. Nucl. Technol.; 28: No. 3, 374-382(Mar 1976).

The Clinch River Breeder Reactor Plant steam generator that transfers the heat from the sodium system to the high-pressure system must maintain integrity and separation of the two fluids. The construction material used for the tubing and tubesheet is high-purity 2¼ Cr–1 Mo alloy steel. To attain confidence in successful manufacturing of the evaporator and superheater modules, key development activities are under way (a) to procure high-quality wrought materials, (b) to assure proper assembly (with emphasis on welding), and (c) to assure that adequate nondestructive testing methods are available to examine the units. (auth)

28054 TRIBOLOGY IN THE CORE OF A SODIUM-COOLED FAST BREEDER REACTOR. Wild, E.; Mack, K. J. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Wear; 34: 331-340 (1975).

From 3rd international tribology conference, "Tribology for the Eighties"; Paisley, Scotland (22 Sep 1975).

The construction of safe and reliable liquid metal cooled fast breeder reactor plants involves knowledge of the friction and wear behavior of different materials in contact with or sliding against each other. Friction and wear problems have been investigated as part of a continuing program to provide guidelines for reactor designers. Following initial experiments to select materials resistant to sodium corrosion and wear, wear rate as a function of the geometrical probe arrangements has been studied. The frictional characteristics of different probe arrangements at various sodium temperatures under different movements with varied dwell times were investigated. The materials tested included Stellite 6, Hastelloy C, Inconel 718, Nimonic 90 and 10 CrMoNiNb 910. (auth)

28055 NEW TYPES OF MONITORING AND CONTROL EQUIPMENT FOR TRACE-HEATED REACTOR PLANTS. Hans, R. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). Siemens Rev.; 42: No. 5, 219-224(May 1975).

Trace heating has to be used to keep the sodium coolant in breeder reactors liquid. To ensure the necessary reliability, a power-failure monitor and control and monitoring unit have been developed, which can also be used for other types of plants as well. The jobs they perform are described in detail together with their mode of operation and data. (auth)

28056 SODIUM CONTAMINATION MEASUREMENT WITH PLUGGING METER AND HYDROGEN LEAK DETECTION SYSTEM. Hans, R.; Weiss, H. J. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). Siemens Rev.; 42: No. 5, 225-228(May 1975).

The presence of oxygen and hydrogen in sodium used as a cooling medium in nuclear power stations jeopardizes safe operation of the plant. A certain degree of purity must therefore be maintained. The plugging meter determines the temperature at which solid particles begin to separate from the sodium and makes it possible to determine the dissolved impurities. The hydrogen detection system monitors the system for minor leaks. Nickel membranes permit the hydrogen to be separated from the sodium and measured. The design and mode of operation of equipment used are described. (auth)

28057 LMFBR WITH BOOSTER PUMP IN PUMPING LOOP. Rubinstein, H. J. (to U. S. Energy Research and Development Administration). US Patent 3,912,584. G21C15/24. 14 Oct 1975. Filed date 9 Jan 1974. 6p.

PAT-APPL-432,007.

A loop coolant circulation system is described for a liquid metal fast breeder reactor (LMFBR) utilizing a low head, high specific speed booster pump in the hot leg of the coolant loop with the main pump located in the cold leg of the loop, thereby providing the advantages of operating the main pump in the hot leg with the reliability of cold leg pump operation.

28058 ENERGY ABSORBER FOR SODIUM-HEATED HEAT EXCHANGER. Essebaggers, J. (to U. S. Energy Research and Development Administration). US Patent 3,924,675. F28f9/00. 9 Dec 1975. Filed date 3 May 1973. 4p.

PAT-APPL-356,879.

A heat exchanger is described in which water-carrying tubes are heated by liquid sodium and in which the results of accidental contact between the water and the sodium caused by failure of one or more of the water tubes is minimized. An energy absorbing chamber contains a compressible gas and is connected to the body of flowing sodium by a channel so that, in the event of a sodium-water reaction, products of the reaction will partially fill the energy absorbing chamber to attenuate the rise in pressure within the heat exchanger.

28059 REACTOR VESSEL SEAL SERVICE FIXTURE. Ritz, W. C. (to U. S. Energy Research and Development Administration). US Patent 3,922,748. F22B37/48. 2 Dec 1975. Filed date 9 May 1974. 4p.

PAT-APPL-468,322.

An apparatus for the preparation of exposed sealing surfaces along the open rim of a nuclear reactor vessel comprised of a motorized mechanism for traveling along the rim and simultaneously brushing the exposed surfaces is described.

28060 METHOD OF REMOVING BULK SODIUM FROM METALLIC SURFACES. Maffei, H. P.; Borisch, R. R. (to U. S. Energy Research and Development Administration). US Patent 3,918,961. C22B27/00. 11 Nov 1975. Filed date 12 Dec 1974. 8p.

PAT-APPL-532,138.

A process of removing sodium from an article, particularly one made of stainless steel, by treating it with a mixture of water vapor and a gas which is inert to sodium is described. By selecting combinations of temperature and water vapor-to-gas

ratio, the reaction temperature is controlled to prevent damage to the articles.

28061 LIQUID METAL PUMP FOR NUCLEAR REACTORS. Allen H. G.; Maloney, J. R. (to U. S. Energy Research and Development Administration). US Patent 3,910,714. F04D1/00; F04D7/02. 7 Oct 1975. Filed date 11 Dec 1974. 4p.
PAT-APPL-531,589.

A pump for use in pumping high temperature liquids at high pressures, particularly liquid metals used to cool nuclear reactors is described. It is of the type in which the rotor is submerged in a sump but is fed by an inlet duct which bypasses the sump. A chamber, kept full of fluid, surrounds the pump casing into which fluid is bled from the pump discharge and from which fluid is fed to the rotor bearings and hence to the sump. This equalizes pressure inside and outside the pump casing and reduces or eliminates the thermal shock to the bearings and sump tank.

28062 PROGRESS IN FAST BREEDER DEVELOPMENT. Traube, K. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). Atomwirtsch., Atomtech.; 20: No. 10, 489-497(Oct 1975). (In German).
From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975). 15 figs.; 1 tab.; 7 refs.

Most of the prototype fast breeder reactors are either still under construction or in their commissioning phases. The experience accumulated with these prototypes has proved the technical feasibility of large LMFBR power stations. The commercial use of fast breeders, that is, the operation of a large number of big breeder power stations, is envisaged still for the eighties in France and Britain, for the nineties in the Federal Republic, the U. S. and Japan. Delays in the construction of the SNR-300 are not due to technical difficulties but to the licensing procedure for such a new plant. Nevertheless, the overall progress achieved in this project may be regarded as being satisfactory. Even the extra cost resulting from additional conditions imposed as a result of the licensing procedure are on an order of magnitude which is still tolerable for a project of these dimensions. Major progress is expected to result from the commissioning of the KNK II reactor expected for the spring of 1976. (DE)

28063 FAST NEUTRON REACTOR. Iljunin, V. G.; Kuznetsov, I. A.; Murogov, V. M.; Silaev, J. V.; Shmelev, A. N. French Patent 2,229,118/A/. 11 May 1973. 9p. (In French).

The nuclear reactor forming the object of the invention is characterized in that at least some of its packs of fuel elements are divided, in the flow direction of the coolant, into at least two areas, the fuel elements of which contain different fuels. In the area at lower coolant temperature, the concentration of heavy nuclei or fissile isotopes of the fuel is greater. (FR)

28064 WELDED STRUCTURE OF THE FAST NEUTRON REACTOR "PHENIX". Megy, J. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)); Payan, G. (Societe Creusot-Loire, 75 - Paris (France)); Salon, G. (Societe Stein Industrie, 75 - Paris (France)). Soudage Tech. Connexes; 29: No. 5, 165-181(May 1975). (In French).
From meeting of the French Society of Welding Engineers; Paris, France (23 Jan 1975).

The different parts of the "Phenix" power plant are briefly described. The dimensional requirements for the construction of the various components of the Phenix pile block, the steel used, and the preparation of welded assemblies are presented. The plate working and welding techniques used for each component are described, along with the testing methods (dimensional testing, weld testing). Steam generators and intermediate exchangers are described (particularly design characteristics, steels used, welding techniques and weld testing). (FR)

28065 LEAK TESTING OF THE WELDED JOINTS OF THE PHENIX REACTOR VESSELS. Blanc, B.; Roulliay, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). pp 84-90 of Meeting on Leak Detection and Helium-Tightness Tests. May 16, 1972. Proceedings. Paris, France; Comite Francais d'Etude des Essais Non Destructifs ([nd]). (In French).
From meeting on leak detection and helium-tightness tests; Paris, France (16 May 1972). Special edition of Revue de Metallurgie and Soudage et Techniques connexes,

Helium leak testing was effected during the assembly of the Phenix reactor vessels: main vessel and double envelope vessel. The structure of the Phenix reactor block is described together with the testing method used. (FR)

28066 STUDY OF SODIUM-WATER REACTION IN THE EVAPORATION MODULE OF PHENIX. Comparison Between Experimental Results and Analogic Calculation. Lacroix, A.; Lions, N.; Trimouille, C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). pp 575-592 of Heat Exchangers. 9. International Meeting, Paris, 16-18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974). (In French).
From international meeting on heat exchangers; Paris, France (16 Jun 1971).

Results are presented of the sodium-water reaction tests carried out during 1968 and 1969, in an evaporator module of the Stein-Industrie Steam generator (Phenix prototype) associated to a sodium loop of about 100 kW power. The experimental results are compared to the results of theoretical values calculated with an analog computer program. (FR)

28067 CODE OF HYBRID CALCULATION FOR THE STUDY OF HEAT EXCHANGERS. Chareton, H.; Corriol, J. L.; Poulard, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France)). pp 173-194 of Heat Exchangers. 9. International Meeting, Paris, 16-18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974). (In French).
From international meeting on heat exchangers; Paris, France (16 Jun 1971).

A series integration method has been chosen, machine time being similar to space, the computer storing the solutions passed to allow for an approximation at the finished differences of the timed derivatives. Space distributions of the functions of state (enthalpy and temperature) of the two fluids are calculated by analogical integration in the direction of the circulation of the fluids. This is made possible by the disconnection of the two fluids thanks to a method of prediction-correction for the equation of the wall. The great rapidity of the analogical integrations and the absence of iterations make the calculation in actual time possible (assuming that 200 points are taken for the storage of the solutions passed, the time required for a full calculation is 0.4 second). It is, therefore, possible to integrate this simulation in an actual (for example nuclear station) or simulated loop. The program allows for the simulation of any exchanger (different fluid, variable geometry, etc.) or any number of exchangers interlinked by a given sequence. However, particular consideration will be given to the simulation by this program of the terminal exchanger of the Phenix reactor within the framework of a general simulation of the station. (FR)

28068 DISCHARGE OF GASEOUS FISSION PRODUCTS FROM FUEL ELEMENTS OF NONHERMETIC CONSTRUCTION. Gryazev, V. M.; Konyashov, V. V.; Polyakov, V. N.; Chechetkin, Yu. V. Sov. At. Energy (Engl. Transl.); 38: No. 4, 313-314(Apr 1975).
Translated from At. Energ.; 38: No. 4, 249-250(Apr 1975).

In order to investigate the efficiency of vented fuel elements and to determine the fractional discharge of gaseous fission products (GFP) in a BOR-60 reactor, tests were conducted on two assemblies of 37 fuel elements with special, nonhermetic subassemblies. The conditions for the irradiation of the fuel elements were similar to operational conditions. Results indicate that the loading of the active zone of a BOR-60 reactor with assemblies of nonhermetic construction does not result in an intolerable increase in the level of radioactivity in the sodium coolant and gas cavities. When stable fission products are retained under the jacket, a reduction in the detention time of the GFPs and an increase in their fractional discharge from fuel elements of nonhermetic construction is permissible. (auth)

28069 EUROPEAN BREEDERS. I. France Leads the Way. Metz, W. Science; 190: No. 4221, 1279-1281(26 Dec 1975).

The breeder reactor programs in European countries, particularly the well-advanced French program, are reviewed.

28070 EUROPEAN BREEDERS (III): FUELS AND FUEL CYCLE ARE KEYS TO ECONOMY. Metz, W. D. Science; 191: No. 4227, 551-553(13 Feb 1976).

Some of the economic advantages and some of the technical problems in the breeder reactor fuel cycle are discussed. The European breeder fuel cycle is discussed under the following headings: fabrication facilities, breeder reprocessing plants, reactor safety provisions, and different national attitudes. (JWR)

28071 BOUNDARY-VALUE THERMAL-HYDRAULIC ANALYSIS OF A REACTOR FUEL ROD BUNDLE. Sha, W. T.; Schmitt, R. C.; Huebotter, P. R. (Argonne National Lab., IL). Nucl. Sci. Eng.; 59: No. 2, 140-160(Feb 1976).

A new computational model for steady-state, single-phase, thermal-hydraulic, multichannel analysis of fluid flow through nuclear reactor fuel elements is presented. The model accounts for the conservation of mass, energy, and momentum subject to pressure-drop boundary conditions and leads to a nonlinear multipoint boundary-value problem. The turbulent interchange,

radial thermal conduction, and forced flow due to the wire-wrap or grid between the channels are explicitly taken into account. The temperature distribution of the coolant, cladding, and fuel, and the size of the central void of the oxide fuel after thermal restructuring are computed in the model. Three different thermal-hydraulic channel arrangements, i.e., square, hexagonal, and triangular, can be treated by the method presented here. Multipin analysis with transverse interactions or multiassembly calculations without transverse interactions between the channels can be performed. The most important features of this new computational model are: (a) that the effect of axial flow area variation has been incorporated into the derivation of governing equations, (b) that the cross-flow approximation has been improved so that the assumption of constant transverse momentum flux in the direction under consideration is removed, and (c) that partial flow blockage occurring anywhere along the flow path can be analyzed, and the effect on the inlet mass velocity redistribution can be taken into account. (auth)

28072 MONTE CARLO CODE FOR THE EVALUATION OF THE THERMAL DESIGN OF A NUCLEAR REACTOR CORE. Miki, K.; Inoue, K. (Hitachi Ltd., Kawasaki, Japan). Nucl. Sci. Eng.; 59: No. 2, 161-169 (Feb 1976).

A new calculation code, the Hot Spot Probabilistic Evaluation Code (HOSPEC), is presented for evaluating hot-spot factors in a fast reactor. This code calculates the probability distribution of temperature in the whole core by means of a Monte Carlo method. Each Monte Carlo trial involves a complete thermal conduction analysis, thereby reducing errors due to assumptions in analytic procedures currently in use. With this code it is possible to determine the probability that fuel pellets, fuel pins, or subassemblies will exceed the limiting temperature, as well as determine the number of such "hot spots" that will develop. A quantitative comparison is made of the results obtained from this code with those from other analyses of a prototype fast reactor. The comparison has indicated, among other points, the following findings: 1. For zero hot spots, a conventional analytic evaluation code SHOSPA gives conservative results, i.e., approximately 20°C at the fuel center, at a 3 sigma confidence level. 2. It is of crucial importance to take into account the temperature dependence of the properties of the materials. Neglecting such dependence leads to a much more conservative temperature prediction, e.g., approximately 50°C at the fuel center.

Research, Test, and Experimental Reactors

Refer also to abstracts 27993 and 28034.

28073 (AD-A-009344) THERMIONIC CONVERSION IN 1972. Karetnikov, D. 20 Nov 1974. Translation of Report of the International Information Panel on Thermoemission Conversion (8th Session). n.p., n.d. (FSTC-HT-23-0249-75). 5p. NTIS $3.25.

The Topaz-3 thermionic reactor was tested to obtain a longer service life and higher efficiency coefficient. (GRA)

28074 (HEDL-TI-76004) FFTF PROGRESS HIGHLIGHTS, WINTER 1975–1976. Weber, S. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1 Jul 1975. 30p. Dep. NTIS $4.00.

Milestones concerning equipment, reactor components, and testing and operations at the FFTF since July 1, 1975 are highlighted. (JWR)

28075 (HEDL-SA-921) FTR TAG BURNUP. Kidman, R. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1976. 26p. (CONF-750607-52). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The gas tag burnup changes investigated were limited to the three tags (Kr-78/Kr-80, Xe-126/Xe-129 and Kr-82/Kr-80) currently accepted as being the most desirable. Control rod tag burnup was significantly greater than fuel rod tag burnup. This occurs because control rods stay in the reactor longer and occupy positions of greater low-energy flux. Thus, minimum tag spacings were set by the control rods as 1.079 for Kr-78/Kr-80, 1.189 for Xe-126/Xe-129 and 1.134 for Kr-82/Kr-80.

28076 (NP-20780) AQUEOUS HOMOGENEOUS SUSPENSION REACTOR PROJECT. Report for 2nd Quarter, 1975. (Keuring van Electrotechnische Materialen N. V., Arnhem (Netherlands)). 1975. 28p. Dep. NTIS (US Sales Only) $5.00.

Included are data on KSTR operation, reactor kinetics, chemistry, technology, safety, and conceptual design studies. (DG)

28077 (SAND-75-0630) ANNULAR CORE PULSE REACTOR UPGRADE QUARTERLY REPORT, JULY–SEPTEMBER 1975. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 47p. Dep. NTIS $5.00.

Progress is summarized in the following task areas: safety, documentation, and compliance; core nuclear design; console development; mechanical design; fuel element design; primary fuel material studies; secondary fuel material studies; driver core fuel element; and fuel motion diagnostic system. A project schedule is included.

28078 (SAND-75-6236) DESIGN AND INITIAL PERFORMANCE OF THE SANDIA PULSED REACTOR-III. Reuscher, J. A.; Estes, B. F. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1976. 23p. (CONF-760111-3). Dep. NTIS $3.50.

From US/Japan seminar on fast pulse reactors; Tokai, Japan (19 Jan 1976).

The Sandia Pulsed Reactor-III (SPR-III) is a new fast pulsed reactor which has recently undergone initial testing at Sandia Laboratories. SPR-III is a uranium-10 weight percent molybdenum fuel assembly with a 17.78 cm irradiation cavity similar in design to SPR-II which has been in operation since 1967. The basic SPR-III design utilizes the same split-core configuration which has been proven with SPR-II; however, SPR-III uses external reflectors for control and external bolts to hold the fuel plates together. The core consists of sixteen fuel plates with an inside diameter of 17.78 cm, an outside diameter of 29.72 cm, and a core height of 31.9 cm. The fuel mass is about 227 kg of fully enriched uranium-10 weight percent molybdenum alloy. SPR III has completed the initial series of startup tests which included the critical experiment, zero and low-power tests, and pulse testing. The reactor design and results from the initial testing program are described in this paper. A portion of the startup experiments with SPR-III have been completed and this paper discusses the more important aspects of the initial testing program.

28079 (SAND-75-6238) DYNAMIC THERMOMECHANICAL BEHAVIOR OF THE SANDIA PULSED REACTOR-III. Reuscher, J. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1976. 20p. (CONF-760111-2). Dep. NTIS $3.50.

From US/Japan seminar on fast pulse reactors; Tokai, Japan (19 Jan 1976).

The theoretical and measured mechanical behavior of SPR-III during pulse operation is described. The core was instrumented with noncontacting displacement transducers and the oscillations of the fuel plates and support structure were recorded. A method for calculating the fuel stresses using surface oscillations is described. The dynamic, thermal stress results were obtained from a two-dimensional, finite difference analysis which included temperature dependent properties.

28080 (WARD-2171-55) RESOLUTION OF SURFACE DEFECT PROBLEM IN SENSITIZED TYPE 304 STAINLESS STEEL PUMP PARTS FOR FFTF. Cwynar, J. C.; France, L. L.; Ray, W. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). Feb 1976. Contract E(45-1)-2171. 126p. AT.

During the third quarter of CY 1973, evidence of intergranular attack (IGA) was found in the containment tanks and shield plug/support cylinder (SP/SC) assemblies of the FFTF primary pumps, then in manufacture. The indications were confined to Type 304 stainless steel plate and forging material which had been subjected to a long-term anneal at 1150°F to assure the in-service dimensional stability of critical pump components. A fracture mechanics evaluation indicated these cracks to be negligible. However, it could not be established that crack propagation would not occur on external surfaces, particularly in the pressure boundary regions, as a result of stress-corrosion. Only the 4- to 8-inch thick portions of the SP/SC assemblies function as containment boundaries, and since the IGA indications on these portions were few in number, isolated, and very small, it was decided to apply stringent process precautions and use these units without repair. The most feasible repair procedure for the affected portions of the pump tanks was found to be disassembly where required, solution annealing at 1800°F, water quenching, remachining as necessary, and reassembly. An extensive heat treatment study was performed to establish the details of this procedure and determine the metallurgical nature of the reheat-treated components. The repair heat treatment was successfully accomplished for all pump tank parts which has been given the 1150°F anneal. No crack propagation occurred, dimensional stability was such that reworking was unnecessary, and ASTM A393 and A262 Practice A testing showed complete desensitization of the material. (auth)

28081 (WARD-2171-58) FAST FLUX TEST FACILITY QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING AUGUST 31, 1975. (Westinghouse Electric Corp., Pittsburgh, Pa.

(USA). Advanced Reactors Div.). 1975. Contract E(45-1)-2171. 44p. AT.

Progress is summarized in the areas of reactor engineering, head compartment and shielding design, in-vessel handling machine and instrumentation and control systems and components, plant fluid systems and mechanical components, nuclear safety, and reactor technology.

28082 IRRADIATION FACILITIES, HYDRAULIC RABBIT SYSTEM, AND SAMPLE HANDLING FOR THE TRIGA HEIDELBERG II. Krauss, O.; Lorenz, W. J.; Maier-Borst, W.; Ostertag, H. (Deutsches Krebsforschungszentrum, Heidelberg (F. R. Germany). Inst. fuer Nuklearmedizin). Kerntechnik; 17: No. 5, 221-224(May 1975). (In German, English).

Based on eight years' experience with the research reactor TRIGA Heidelberg I, a new concept of the facilities for biomedical irradiation problems has been developed. These ideas have been incorporated in the TRIGA Heidelberg II in the final building of the Institute of Nuclear Medicine in the German Cancer Research Center at Heidelberg. The in-core irradiation stations and an open rotary system, each of which can be loaded and unloaded by a hydraulic transport system, are described in detail. The organization and the equipment for handling large numbers of samples under radiation protection are explained. The advantages of the system are discussed. (DE)

28083 MODELING NEUTRON FLUX DISTRIBUTION IN THE IRT-M REACTOR. Koshelev, F. P. (Tomsk Polytechnic Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 10, 149-151(1975). (In Russian)

Results are presented on modeling the neutron flux distribution by using an electric grid method on passive elements applied to the multiple-zone reactor IRT-M. This reactor has an active zone height of 58 cm and a lattice step of 7.15 cm for 20 fuel assemblies. The reflector is of beryllium and water, while the central neutron trap is made of carbon and water. The control rod material consisted of pressed boron carbide. Modeling of the reactor was performed in a two-group, diffusion approximation. The initial diffusion equations are written in finite-difference form with spacial coordinates, and are compared with Kirchkov equations for current in a model cell. Thus modeling conditions are obtained for relating the unknown values of the model elements to given reactor parameters. The largest relative error in the model on determining fluxes of fast and thermal neutrons was found to be 1.7 and 1.8% respectively. (SJR)

28084 RELATIVE DOSE DISTRIBUTION IN THE BIOLOGICAL IRRADIATION FACILITY AT TRIGA MARK-III REACTOR. Kim, B. S.; Ha, C. W.; Lee, C. K. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 7: No. 4, 277-284 (Dec 1975).

A result of measurement for the relative dose distribution of neutron γ mixed radiation field in the biological irradiation facility installed at TRIGA Mark-III reactor is described. The relative dose distributions of neutron-γ mixed radiation field in the biological exposure room have been experimentally determined using a thermoluminescent dosimeter. Experimental results are presented. It was observed that the region commonly having the characteristics of rather homogeneous horizontal and lateral dose distributions is confined to the area bounded by the two planes horizontally parallel to the beam direction with heights of about 40 cm and 130 cm, respectively, at distances beyond 100 cm from the segmentary surface of the aluminum pool liner projected into the exposure room, while other areas show a steeper gradient in dosage, especially the places adjacent to the segment of the aluminum pool liner and near the inner portion of the concrete walls of the exposure room. (auth)

Production and Materials Testing and Processing Reactors

28085 LOADING UNIT FOR INVESTIGATING THE LOW CYCLE FATIGUE OF MATERIALS UNDER THE CONDITIONS OF REACTOR RADIATION. Kiselevskii, V. N.; Skripnik, Yu. D.; Gorokhov, V. E. (Inst. of Problems of Strength, Kiev). Strength Mater. (USSR) (Engl. Transl.); 7: No. 3, 378-380(Mar 1975).

Translated from Probl. Prochnosti; 7: No. 3, 112-114(Mar 1975).

The loading unit is designed for cyclic deformation of the sample with a torque reversing in sign according to specification; it is for experiments in the SM-2 channel reactor. A detailed description is given of the motor, gears, sensor, etc., and the sensitivity threshold is discussed. (DLC)

Propulsion and Package Reactors

Refer also to abstracts 28102, 28106, and 28146.

28086 (CNLM-3415) PRESENTATION TO A COMMITTEE FROM THE NATIONAL ACADEMY OF SCIENCES. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 Feb 1961. 49p. Dep. NTIS $4.00.

Declassified 8 Dec 1975.

Information on the objectives of the CANEL aircraft reactor program is presented.

28087 (CNLM-4082) SNAP-50 REACTOR DEVELOPMENT PROGRAM. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 May 1962. Contract AT(30-1)-2789. 4p. Dep. NTIS $3.50.

Declassified 9 Dec 1975.

The objectives and status of the SNAP-50 development program are summarized.

28088 (CNLM-5185) COMPLIANCE WITH DESIGN OBJECTIVES OF THE MILITARY COMPACT REACTOR. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). [nd]. 7p. Dep. NTIS $3.50.

Declassified 3 Nov 1975.

The LCRE mobile reactor characteristics are compared with requirements for a military compact reactor. (JMR)

28089 (CNLM-5270) MINUTES OF THE SEPTEMBER 16-18 MEETING TO REVIEW THE SNAP-50/SPUR PROGRAM. Frazier, G. N. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 25 Sep 1963. 14p. Dep. NTIS $3.50.

Declassified 5 Nov 1975.

A brief review of the SNAP 50/SPUR program is presented.

28090 (CNLM-5730) DESIGN NO. 1 OF SNAP-50/SPUR REACTOR TEST SYSTEMS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 9 Jun 1964. Contract AT(30-1)-2789. 40p. Dep. NTIS $4.00.

Declassified 8 Dec 1975.

This document presents the initial definition of a 2 Mwt, SNAP-50 Nuclear Powerplant Test and is intended to provide guidance to the Architect/Engineer in evaluating and costing various Nuclear Test Facility design concepts. The powerplant consists of a lithium-cooled reactor in combination with a potassium Rankine cycle power conversion system to provide a nominal 300 Kw of electrical power. The waste heat of the system is rejected by a radiator system which uses NaK as the working fluid. The information is based on preliminary studies; and, consequently, the configuration and component sizes have not been firmly established. Where the Nuclear Test Facility design concept will be affected, however, estimates of reactor test component sizes, envelopes, and requirements are presented where known so that facility design studies can proceed.

28091 (CNLM-5731) DESIGN NO. 2 OF SNAP-50/SPUR REACTOR TEST SYSTEMS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 12 Jun 1963. Contract AT(30-1)-2789. 37p. Dep. NTIS $4.00.

Declassified 8 Dec 1975.

This document presents the initial definition of a 2 Mwt, SNAP-50 Reactor Test and is intended to provide guidance to the Architect/Engineer in evaluating and costing various Nuclear Test Facility design concepts. The information is based on preliminary studies; and, consequently, the configuration and component sizes have not been firmly established. Where the Nuclear Test Facility design concept will be affected, however, estimates of reactor test component sizes, envelopes, and requirements are presented, where known, so that facility design studies can proceed.

28092 (CNLM-5733) DESIGN NO. 4 OF SNAP-50/SPUR REACTOR TEST SYSTEMS. (Stanford Univ., Calif. (USA). Dept. of Materials Science). 17 Jul 1964. Contract AT(30-1)-2789. 39p. Dep. NTIS $4.00.

Declassified 8 Dec 1975.

This document presents the initial definition of a nominal 8 Mwt, SNAP-50 Flight Configuration Nuclear Powerplant Test and is intended to provide guidance to the Architect/Engineer in evaluating and costing various Nuclear Test Facility design concepts. The powerplant consists of a lithium-cooled reactor in combination with four potassium Rankine cycle power conversion systems to provide a nominal 1.2 Mw of electrical power. The heat rejected during condensing and subcooling the potassium vapor is transferred to the main NaK heat rejection loops where

this heat is rejected to air in the proposed ground test instead of radiating to space as in the actual flight item. The information presented is based on preliminary studies; and, consequently, the configuration and component sizes have not been firmly established. Where the Nuclear Test Facility design concept will be affected conservative estimates of reactor test component sizes, envelopes, and requirements are presented so that facility design studies can proceed.

28093 (CNLM-5734) DESIGN NO. 5 OF SNAP-50/SPUR REACTOR TEST SYSTEMS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 9 Jul 1964. Contract AT(30-1)-2789. 43p. Dep. NTIS $4.00.

Declassified 8 Dec 1975.

This document presents the initial definition of a 2 Mwt, SNAP-50 Flight Configuration Nuclear Powerplant Test and is intended to provide guidance to the architect/engineer in evaluating and costing various nuclear test facility design concepts. The powerplant consists of a lithium-cooled reactor in combination with a potassium Rankine cycle power conversion system to provide a nominal 300 Kw of electrical power. The waste heat of the system is rejected by a radiator system which uses NaK as the working fluid. The information is based on preliminary studies; and, consequently, the configuration and component sizes have not been firmly established. Where the nuclear test facility design concept will be affected, however, estimates of reactor test component sizes, envelopes, and requirements are presented where known so that facility design studies can proceed.

28094 (CONF-750758-(Summ.), pp 119-137) UNITED STATES' NUCLEAR MERCHANT SHIP PROGRAM: AN OVERVIEW. Levine, Z. (U. S. Maritime Administration, Washington, DC). Oct 1975.

From meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America (USA) (31 Jul 1975).

In summaries of papers presented at the meeting on small nuclear reactors for industrial energy. (Oak Ridge National Lab., Tenn. (USA)).

Topics discussed include the Maritime Administration Nuclear Merchant Ship Program, licensing and insurance issues, and marine markets. (JWR)

28095 THERMIONIC NUCLEAR REACTOR WITH INTERNAL HEAT DISTRIBUTION AND MULTIPLE DUCT COOLING. Fisher, C. R.; Perry, L. W. Jr. (to U. S. Energy Research and Development Administration). US Patent 3,917,509. G21C15/02. 4 Nov 1975. Filed date 16 Apr 1974. 4p.

PAT-APPL-461,473.

A Thermionic Nuclear Reactor is described having multiple ribbon-like coolant ducts passing through the core, intertwined among the thermionic fuel elements to provide independent cooling paths. Heat pipes are disposed in the core between and adjacent to the thermionic fuel elements and the ribbon ducting, for the purpose of more uniformly distributing the heat of fission among the thermionic fuel elements and the ducts.

Reactor Safety and Environmental Aspects

Refer also to abstracts 25541, 25924, 25971, 25986, 25991, 26021, 26175, 28247, and 28256-28258.

28096 (AD/A-005578) FIELD TEST OF A STEAM CONDENSER HEAT SINK CONCEPT. Quinn, W. F.; Aamot, H.W.C.; Greenberg, M. M. (Cold Regions Research and Engineering Lab., Hanover, N. H. (USA)). Jan 1974. 50p. (CRREL-SR-199). NTIS $3.75.

A concept to reject heat generated by an underground power plant by disposal of exhaust steam to rock tunnels was evaluated by means of a field test. The tunnel walls would, thus, be used to condense the steam and store the heat under a transient heating load. Heat transfer to the rock was initially predicted using the well-known Carslaw and Jaeger analytical model which considers the test tunnel to be represented by a hollow cylinder in an infinite medium initially at a constant temperature. Information was developed regarding the heat transfer coefficient associated with the condensation of steam on rock. Establishing a comparison between the measured and predicted temperatures was complicated by the problem of rock fall which retarded the rate of temperature rise. (GRA)

28097 (AED-CONF-75-365-000, pp v) A REVIEW OF PROCEDURES FOR THE ANALYSIS AND DESIGN OF CONCRETE STRUCTURES TO RESIST MISSILE IMPACT EFFECTS. Kennedy, R. P. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

8 figs.; 3 tabs.; 24 refs. With abstract. Available from ZAED.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

Concrete containment walls and internal concrete barrier walls are often required to withstand the effects of missile impact. Potential missiles include external tornado generated missiles, aircraft crash, and internal accident generated missiles. Impacting missiles can be classified as either "hard" or "soft" depending upon whether the missile deformability is small or large relative to the target deformability. The effects of hard missile impact are examined. Missile velocities between 100 feet/second and 1,500 feet/second are emphasized. Hard missile impact results in both local wall damage and in overall dynamic response of the target wall. Local damage consists of spalling of concrete from the front (impacted) face and scabbing of concrete from the rear face of the target together with missile penetration into the target. If damage is sufficient the missile may perforate or pass through the target. The various empirical procedures commonly used for determining penetration depth, perforation thickness, and scabbing thickness for concrete targets subjected to hard missile impact are reviewed. Results obtained from these procedures are compared with test data results for low velocity impacts (200 feet/second to 1,500 feet/second). Design recommendations to prevent detrimental local wall damage are presented. (DE)

28098 (AED-CONF-75-365-000, pp v) AIRCRAFT IMPACT ON A SPHERICAL SHELL. Hammel, J. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

With figs.; 7 refs. With abstract. Available from ZAED.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

Because of the complexity of an aircraft crash the building is ordinarily loaded by an idealized dynamic load which follows from measurements (aircraft striking a rigid wall). The result of the presented calculations is that the dynamic load of impact of a deformable aircraft on an elastic shell is much more influenced by the aircraft model under consideration than by the elastic displacements of the shell. (DE)

28099 (AED-CONF-75-365-000, pp v) LARGE PLASTIC DEFORMATIONS OF A SPHERICAL SHELL UNDER IMPACT. Stolarski, H. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

12 figs.; 16 refs. With abstract. Available from ZAED.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

An approximate solution to the problem of a spherical cap impacted by a rigid mass is derived. The dimensions of the mass are assumed finite but small as compared to the characteristic dimension of the shell. Following a static solution of a similar problem by Updike a simple mechanism of deformation is assumed in which plastic deformations are spreading out from the center towards the periphery of the shell. This mechanism permits consideration of the shell as a one-degree-of-freedom dynamic system. In the method used no restrictions are set on the value of permanent deflections attained. As a result of numerical computations, plots of the central deflections versus time and maximum central deflections as a function of the kinetic energy input were obtained. The presented solution might be of some value in the design of nuclear power plant containment structures for aircraft crash impact forces. (DE)

28100 (AED-CONF-75-365-000, pp v) CALCULATION OF THE TOTAL FORCE ACTING UPON A RIGID WALL BY PROJECTILES. Drittler, K.; Gruner, P. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

11 figs.; 4 refs. With abstract. Available from ZAED.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

A numerical method is presented which allows for the calculation of the total force acting upon a building during the impact of a projectile. The structural part to be hit by the projectile is assumed to be rigid; its surface is perpendicular to the direction of impact. Flight trajectory and projectile axes coincide. Variations of geometric and material properties across the projectile

axis are replaced by proper average values. The computation algorithm is based on a difference method. The projectile model has to be divided into elements along the flight trajectory. Except for the elements at the beginning and the end of the projectile each element is in equilibrium with its neighbor elements. Different elastic and plastic material properties for each element can be taken into account. Strongly deformed elements are assumed to become separated from the projectile. The impact of all debris is calculated as a part of the total force acting on the wall. The method is tailored to safety considerations. A parametric study of the force resulting from the impact of a turbine of a military aircraft is discussed. It is shown that for safety considerations a simplified function between force and time can be established. (DE)

28101 (AED-CONF-75-365-000, pp v) AIRCRAFT CRASH PROTECTION FROM A MILITARY ENGINEERING POINT OF VIEW. Lynch, J. P. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

4 refs. With abstract. Available from ZAED.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

The general problem is to investigate the situation of an aircraft crash on a reactor building. One aspect of the problem is to determine if the structural conditions required to protect the environment against the results of an impact at the center of a 10 m by 10 m reinforced concrete wall slab are reasonable. The dynamic structural response problem is discussed, using the analytical methods developed for military structures designed to resist blast loading. The military protection problem is quite similar to reactor protection in that extensive analysis is required to define the threat of loading conditions. The post-dynamic-loading structural requirements must also be defined, since every possible source of resistance is used to obtain a structure which protects against the stated threat at the lowest cost. Such a structural design contains the lowest possible factor of safety, using reasonable analytical techniques, and is more properly called collapse design. If more protection is provided than required, the cost will be greater than necessary. An aircraft jet engine impact is selected as the loading condition for the protection requirements of the reactor wall panel. Analytical investigation of the impact indicates that the load function can be reasonably well approximated by the half sine wave pressure-time curve. Thus, the maximum pressure and duration of the half sine pressure pulse completely define the load-time history. (DE)

28102 (AED-CONF-75-365-000, pp v) STRUCTURAL ANALYSIS OF AIRCRAFT IMPACT ON A NUCLEAR POWERED SHIP. Dietrich, R. 1975. (In German).

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

18 figs.; 9 refs. With abstract in English. Available from ZAED.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

It is assumed that a military jet-fighter PHANTOM hits a nuclear powered ship. The total reaction force due to such an aircraft impact on a rigid barrier is specified in the guidelines of the Reaktor-Sicherheitskommission for PWRs. The aircraft impact on the collision barrier at the side of the ship is investigated. The aircraft impact on top of the reactor hatchway is investigated by another analysis. It appears that the most unfavorable angle of impact is always normal to the surface of the collision barrier. Consequently, only normal impact will be considered. For the specific case of an aircraft striking a nuclear powered ship, the following two effects are considered: (1) local penetration and (2) dynamic response of the structure. The results show that the highest penetration depth is less than the sum of all wall thicknesses of the collision barrier. The solution of the dynamic analysis is obtained by using the finite element method. The results are the eigenmodes, the eigenfrequencies, the displacement of the nodes, and the stresses in the applied plane stress elements. It is shown that the maximum stress which appeared only in one element is on the same level as the yield stress of the steel. The structural analysis shows that the collision barrier is a sufficient safeguard against the penetration of the engine and against the cracking of the structure as a result of the dynamic response to an aircraft impact. (DE)

28103 (AED-CONF-75-365-000, pp v) GAS CLOUD EXPLOSIONS AND RESULTING BLAST EFFECTS. Pfoertner, H. 1975. (In German).

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

6 figs. With abstract in English.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

The design of nuclear power plant structures to resist blast effects due to chemical explosions requires the determination of load-time functions of possible blast waves. Whether the explosion of a hydrocarbon gas in the atmosphere will occur in the form of a deflagration or a detonation is largely dependent on the type of flame acceleration process which is closely related to the rate of energy release. Flame propagations at normal flame velocities in a free explosive gas cloud will certainly not lead to a detonation. With sufficiently large clouds, however, the flame acceleration could become so high that an initial deflagration changes into a detonative process. Results of recent investigations show that in a free cloud with deflagrative ignition (flame, heated wire, sparks) the occurrence of a gas detonation can practically be excluded. The TNT equivalent for hydrocarbons is specified by means of energy considerations including the propagation functions for the case of spherically symmetric detonations. It follows that with regard to the effects 1 kg of hydrocarbon could be equated to about 1 kg TNT. In analogous manner to the safety distances required in the handling and storage of high-explosives a mass-distance relation of the form $R = k \times L^{\frac{1}{3}}$ could be considered, where L is the mass of spontaneously released hydrocarbon and k varies only with the structural shape of the blast loaded buildings. (DE)

28104 (AED-CONF-75-365-000, pp v) BASIC IDEAS OF A PHILOSOPHY TO PROTECT NUCLEAR PLANTS AGAINST SHOCK WAVES RELATED TO CHEMICAL REACTIONS. Jungclaus, D. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

12 figs.; 3 tabs.; 9 refs. With abstract. Available from ZAED.

In containment structure impact and pressure pulse loading. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

The problem of shock-wave loading first was dealt with in the design of the nuclear power plant near Brunsbuettel, since in the neighborhood a large chemical plant was under construction. The gaseous hydrocarbons (under normal conditions), stored in a fluid state by means of pressure or deep cooling, are considered as being particularly dangerous. By theoretical considerations a load-function has been derived to describe the effect of an accident. The pressure-time diagram was deduced on the basis of the assumption that an explosion of a gas cloud would occur only in form of a deflagration. It is possible to get higher loadings after accidents with unsaturated hydrocarbons. A conservative and therefore safe assessment is possible if this form of an explosion is taken into account. The possibility of this form of reaction has been shown in experiments. Quasi-static pressures up to approximately 20 bars have been measured. It seems to not be realistic to design buildings of nuclear power plants to withstand such loadings. Therefore, distances from the nuclear power plant have been calculated, in which a detonation may occur without generating a higher loading than that evaluated for the deflagration of a gas cloud. The assumptions and models to evaluate the pressure-time-function in the case of deflagration and the safety distances in the case of detonation are discussed. (DE)

28105 (AED-CONF-75-365-000, pp v) CONCEPTUAL STUDIES FOR UNDERGROUND SITING OF HIGH-TEMPERATURE GAS-COOLED POWER REACTORS. Kroeger, W.; Altes, J. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

8 figs.; 7 tabs.; 25 refs. With abstract. Available from ZAED.

In extreme loading and response of nuclear power plant structures. Special containment structures. General surveys. Probabilistic assessments. Underground power reactor containments. Protective structures for nuclear powered ships. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

Contrary to foreign activities aiming at siting deep in rock, in the FRG research is done on cut-and-fill technique in soil because of topographical and geological conditions. The HTR offers itself because of high safety and variety of applications. Underground material acts as additional confinement of radioactivity, becoming effective after hypothetical failure of containment. The transport of contaminants is extremely delayed, decisively influenced by actual underground conditions. The most important radioactive materials are retained almost totally by way of ion exchange (Cs, Sr) and physical adsorption (iodine, noble gas to a certain extent). Because of mitigated spread of activity an inadmissible contamination of groundwater will not occur especially as counter-measures are possible. Ground-level release of radioactive noble gases can be prevented by the lay-out of back-filling and coverage. Underground-siting

guarantees better protection against extreme external effects which must be taken into account to avoid common mode failure. Shock waves can be eliminated as well as area conflagration and aircraft impact by adequate coverage. Solid layers of soil will have a positive effect on seismic behavior of the embedded structure, not at last because of damping. Underground-siting causes easier solution of decommissioning problems, high adaptability to future requirements, and better protection against sabotage and direct radiation. For the realization of large pits different techniques are available. They will be discussed in connection with a concept for underground siting of a HTR plant. An approximate site-independent safety is ensured by a firm and impermeable back-filling of the clearance between the pit wall and the containment structure. Costs and construction time must be estimated in detail taking into account all influencing factors. (DE)

28106 (AED-CONF-75-365-000, pp v) ON THE COLLISION PROTECTION OF SHIPS. Jones, N. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

2 figs.; 48 refs. With abstract. Available from ZAED.

In extreme loading and response of nuclear power plant structures. Special containment structures. General surveys. Probabilistic assessments. Underground power reactor containments. Protective structures for nuclear powered ships. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

A brief discussion is presented of the current state of knowledge on the collision protection of land based vehicles. The experimental and theoretical investigations which have been conducted into the collision protection of various types of ships are then reviewed. An examination is made of various energy absorbing methods which are discussed with particular emphasis on their suitability for the protection of ships involved in collisions. The behavior of hexagonal cell (honeycomb) structures is investigated in some detail, and alternate structural arrangements in ships and marine vehicles which utilize honeycomb energy absorbing systems are suggested. (DE)

28107 (AED-CONF-75-365-000, pp v) CHARACTERIZATION OF STRUCTURAL DAMAGE CAUSED BY EXTREME DYNAMIC LOADS. Habip, L. M. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

16 figs.; 21 refs. With abstract. Available from ZAED.

In extreme loading and response of nuclear power plant structures. Special containment structures. General surveys. Probabilistic assessments. Underground power reactor containments. Protective structures for nuclear powered ships. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

A general survey of modern methods of design and analysis in the field of structural effects of extreme dynamic loads is presented. Starting with an analysis of the linear oscillator subjected to a blast pulse, it is shown that the pressure-impulse contour, a curve relating the peak pressure and the impulse necessary for a specified peak displacement, is a practical representation of a dynamic damage threshold or failure boundary which separates the pressure-impulse plane into regions of damage and no damage. The method has also proved useful when applied to failure data for a variety of continuous systems exhibiting several physically different modes of damage due to dynamic loading. Examples for beams, plates, and shells are given. A number of analytical methods for calculating the permanent dynamic deformation of structures and solid continua are also discussed. The present state of development of dynamic limit analysis, finite difference and finite element methods is reviewed. Commercially available software packages are described and some of their typical applications exhibited. Specific recommendations for future research concerning both the design and analysis aspects of the problem are given. (DE)

28108 (AED-CONF-75-365-000, pp v) PEAK LOAD-IMPULSE CHARACTERIZATION OF CRITICAL PULSE LOADS IN STRUCTURAL DYNAMICS. Abrahamson, G. R.; Lindberg, H. E. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

15 figs.; 12 refs. With abstract. Available from ZAED.

In extreme loading and response of nuclear power plant structures. Special containment structures. General surveys. Probabilistic assessments. Underground power reactor containments. Protective structures for nuclear powered ships. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

In presenting the characterization scheme, some general features are described. A detailed analysis is given for the rigid-plastic system of one degree of freedom to illustrate the calculation of critical load curves in terms of peak load and impulse. This is followed by the presentation of critical load curves for uniformly loaded rigid-plastic beams and plates and for dynamic buckling of cylindrical shells under uniform lateral loads. The peak load-impulse characterization of critical pulse loads is compared with the dynamic load factor characterization, and some aspects of the history of the peak load-pulse scheme are presented. (DE)

28109 (AED-CONF-75-365-000, pp v) EXTREME VALUE RISK ANALYSIS IN THE STRUCTURAL DESIGN OF REACTOR COMPONENTS. Freudenthal, A. M. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

5 refs. With abstract. Available from ZAED.

In extreme loading and response of nuclear power plant structures. Special containment structures. General surveys. Probabilistic assessments. Underground power reactor containments. Protective structures for nuclear powered ships. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

The tendency to confuse "uncertainties" associated with design assumptions and parameters and compensated by the safety factor with objective "risks of failure" implicit in the design has been characteristic of the approach to probability-based structural design on all levels. However, a clear differentiation between uncertainty and risk is required to remove the lack of correlation between design safety analysis and risk analysis, implicit in the present approach to the design of major structural and mechanical components of nuclear reactors as well as other structures. In a recent paper the author has used the definition of the safety factor as a random variable (distribution of a quotient) to construct a probability model that justifies the introduction of the asymptotic distributions of extreme values as the physically relevant distributions of the design parameter governing ultimate load failure on which a realistic risk assessment can be based. Realistic reliability and risk assessment of reactor components subject to fatigue and creep, i.e., design conditions that exceed in practical importance that of ultimate load failure, can be based on the use of the third asymptotic distribution of smallest values. (DE)

28110 (AED-CONF-75-365-000, pp v) SOME ASPECTS OF THE RELIABILITY-BASED DESIGN OF REACTOR CONTAINMENT STRUCTURES. Schueller, G. I. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

4 figs.; 1 tab.; 19 refs. With abstract. Available from ZAED.

In extreme loading and response of nuclear power plant structures. Special containment structures. General surveys. Probabilistic assessments. Underground power reactor containments. Protective structures for nuclear powered ships. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

It is generally recognized that the load which a structure is likely to experience during its design life as well as its resistance are to be represented by random variables. A rational design procedure for reactor containment structures can therefore only be carried out within a probabilistic framework. Internal load conditions caused by system failure such as loss-of-coolant accident, pressure loads etc., and external load conditions caused for instance by impact due to aircraft crashes, external pressure waves and natural hazards such as earthquakes, floods, hurricanes are described by extreme value distributions of the Fisher-Tippett types. Statistical and physical arguments are given to support their application. The occurrence of these rare events with respect to time is modeled by a Poisson process. The yield strength of the containment structure for both steel (liner) and reinforced concrete shells is also modeled by extreme value distributions (of the smallest values). The failure criterion considered here is that of collapse determined by plastic yieldline formation. A failure mechanism as considered here describes a particular regime of plastic line formation. The probability of failure of a structure under a single load application of load types likely to occur during the design life of the structure is to be determined by integrating over all possible mechanisms. Finally Freudenthal's reliability function is utilized to combine the information derived above so that a containment design for given design life and reliability is possible. (DE)

28111 (AED-CONF-75-365-000, pp v) DYNAMIC ANALYSIS AND STRUCTURAL DESIGN OF UNDERGROUND NUCLEAR REACTOR CONTAINMENTS. Kierans, T. W.; Reddy, D. V.; Heale, D. G. 1975.

From international seminar on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; Berlin, F. R. Germany (8 Sep 1975).

3 figs.; 4 tabs.; 56 refs. With abstract. Available from ZAED.

In extreme loading and response of nuclear power plant structures. Special containment structures. General surveys. Probabilistic assessments. Underground power reactor containments. Protective structures for nuclear powered ships. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)).

All concept options are assumed to be similar in design criteria for structural competence to contain radioactivity and fuel heat and meet the functional, servicing, protective and aesthetic requirements. The choice of underground siting should be based on criteria developed from the sequential consideration of load-causing phenomena, concept and site characteristics. From the criteria, loads for a particular concept and site are calculated and the design formulated. (DE)

28112 (AED-CONF-75-483-001) THE NUCLEAR CONTROVERSY INTERNATIONAL. Doederlein, J. M. (Institutt for Atomenergi, Kjeller (Norway)). 1975. 39p. INIS.

From meeting on environmental load due to nuclear energy; Geesthacht, F. R. Germany (13 Mar 1975).

The following questions are considered: (1) How quickly can the developed nations get as much energy as possible from the nuclear power plants they are building. (2) How can we get a maximum output from a maximum number of nuclear plants to reduce the health and the environment damage that we get from fossil fired power plants. (3) How can we reduce the strain on future generations because of the atmospheric pollution and reduce the strain on future generations because we use up all the oil and the gas that we should leave to them for worthier purposes than energy production. (DE)

28113 (AEEW-M-1253) SOME ASPECTS OF MODEL IMPROVEMENTS IN RELAP-UK. Brittain, I.; Fayers, F. J. UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). Mar 1974. 44p. Dep. NTIS (US Sales Only) $4.00.

Details are given of changes in model which have been, or are about to be, implemented in the UK version of RELAP III. The changes embrace features representing steam slip ratio, momentum flux terms including change of area, frictional pressure drop interaction with discharge conditions, options for discharge models, the Smith slip ratio and two-phase multiplier, modifications to dryout and rewetting criteria, bubble rise in a horizontal steam drum, pipework heat and radiation cooling, spray cooling under stagnant conditions, determination of steady state conditions, and inclusion of a slave pin calculation. Most of these features are already programmed, those on which work is continuing being indicated in the text.

28114 (AEEW-R-1029) EXPEL: A COMPUTING MODULE FOR MOLTEN FUEL/COOLANT INTERACTIONS IN FAST REACTOR SUB-ASSEMBLIES. Fishlock, T. P. (UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). 1975. 44p. Dep. NTIS (US Sales Only) $4.00.

A description is presented of a module for computing the effects of a molten fuel/coolant interaction in a fast reactor subassembly. The module is to be incorporated into the FRAX code which calculates the consequences of hypothetical whole core accidents. Details of the interaction are unknown and in consequence the model contains a large number of parameters which must be set by assumption. By variation of these parameters the interaction may be made mild or explosive. Results of a parametric survey are included. (auth)

28115 (ANCR-1280) EFFECTS OF BURNUP ON FUEL FAILURE. Power Burst Tests on Fuel Rods With 13,000 and 32,000 MWd/MTU burnup. Miller, R. W. (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1976. Contract E(10-1)-1375. 39p. Dep. NTIS $5.00.

Results are presented from preliminary tests designed to investigate the behavior of preirradiated fuel rods under reactivity initiated accident (RIA) conditions. The tests were conducted in 1970 as part of the SPERT/Capsule Driver Core (CDC) program. The report was intended to be published in a series of Idaho Nuclear Corporation Interim Technical Reports (IN-ITRs); however, the CDC program was terminated before the report could be released. In September 1975, the Nuclear Regulatory Commission concluded that the data contained in the report could be a valuable reference in planning future water reactor safety program tests and requested its release.

28116 (ANL-76-5) RADIATIVE COOLING OF A VOIDED SUBASSEMBLY. Chan, S. H.; Condiff, D. W.; Grolmes, M. A. (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. 18p. AT.

A treatment is formulated for surface-to-surface radiative heat exchange between fuel pins and between pins and duct wall of a nuclear-reactor subassembly voided of coolant. Specific attention is given to the case of equal power generation in each pin with uniform duct-wall temperature. Detailed temperature profiles and heat flux values are reported for hexagonal-ring subassemblies ranging in size from one to nine rings. It is found that a duct wall at 1153°K can cool by radiation even a nine-ring voided subassembly operating at a power level of up to 0.54 kW/ft per pin or 5.4 percent of full power without fuel slumping or melting, or that a seven-pin assembly can be cooled by radiation up to a power of 7.3 kW/ft.

28117 (BNL-50467) ADVANCED THERMOHYDRAULIC TRANSIENT CODE FOR LMFBRs. Quarterly Progress Report, July 1-September 30, 1975. Agrawal, A. K. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1975. Contract E(30-1)-16. 100p. Dep. NTIS $6.50.

The objectives and the accomplishments of the SSC research program are described. Briefly, the SSC code is being developed to analyze (1) the consequences of a massive pipe rupture in the primary heat transport system, and (2) the long-term after-heat removal capability from the "loop" type liquid metal cooled fast breeder reactors (LMFBR). In addition, at least some of the "level 2" transients may be analyzed. All of these events assume that the plant protection system is functioning. Pre- or post-hypothetical core disruptive accidents (i.e., off-normal incidences with assumed failure of the reactor scram) are not considered, at least at present, in the scope of the SSC effort. The progress made during this quarter is reported under the following five categories: (1) In-vessel Modeling, (2) Primary Loop Modeling, (3) Intermediate Loop Modeling, (4) Tertiary Loop Modeling, and (5) Code Development. Much of the modeling describing the single-phase coolant dynamics in various regions of the vessel and the heat transfer in fuel rods and its associated structures has been completed. Work on coding these models was initiated. The steady state and transient models for solving the conservation equations for sodium flow in the primary loop have been developed. A test program was written and results for simplified test cases are included. (auth)

28118 (BNWL-B-472) REVIEW OF EXISTING STUDIES AND UNRESOLVED PROBLEMS ASSOCIATED WITH SOCIO-ECONOMIC IMPACT OF NUCLEAR POWERPLANTS. Hendrickson, P. L.; King, J. C.; O'Connell, M. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract E(45-1)-1830. 33p. Dep. NTIS $4.00.

Preparation of socio-economic impact statements for nuclear power plants began only a few years ago. The number of these statements is increasing, and some states, such as Washington, now require them as a condition to state approval for thermal power plants. The major purpose of this paper was to review existing socio-economic impact statements to identify where additional research to improve the impact analysis process would be useful and appropriate. A second purpose was to summarize the type of information included in existing statements. Toward this end a number of socio-economic impact statements were reviewed. Most of the statements are for nuclear power plants; however, some are for other large construction projects. The statements reviewed are largely predictive in nature; i.e., they attempt to predict socio-economic impacts based on the existing knowledge. A few of the reports contain retroactive case studies of plants already completed. One describes an ongoing monitoring analysis of plants under construction. As a result of this preliminary study, a need was identified for a better-defined impact statement methodology and for guidelines identifying appropriate areas for analysis and analytical techniques. (auth)

28119 (CEA-CONF-3161) APPLICATION OF RELIABILITY ANALYSIS METHODS TO THE COMPARISON OF TWO SAFETY CIRCUITS. Signoret, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Surete Nucleaire). 1975. 33p. (In French). INIS.

From INOVA 75th meeting on maintenance; Paris, France (9 Jun 1975).

Two circuits of different design, intended for assuming the "Low Pressure Safety Injection" function in PWR reactors are analyzed using reliability methods. The reliability analysis of these circuits allows the failure trees to be established and the failure probability derived. The dependence of these results on test use and maintenance is emphasized as well as critical paths. The great number of results obtained may allow a well-informed choice taking account of the reliability wanted for the type of circuits. (FR)

28120 (DOCKET-STN-50556-7) BLACK FOX STATION, UNITS 1 AND 2. Application for Construction Permits and Op-

erating Licenses. (Public Service Co. of Oklahoma, Tulsa (USA)). 23 Dec 1975. 157p. (DOCKET-STN-50557-7). Dep. NTIS $6.75.

An application to construct and operate Black Fox Station, Units 1, and 2 is presented. The two BWR type reactors will have a rated core thermal power of 3579 MW(t) and a net electrical power of approximately 1150 MW(e). The facility will be located in Inola Township, 23 miles east of Tulsa on the east side of the Verdigris River in Rogers County, Oklahoma. (FS)

28121 (GA-A-13617(Vol.4)) HTGR ACCIDENT INITIATION AND PROGRESSION ANALYSIS STATUS REPORT. Volume IV. Phase I Analyses and R and D Recommendations. Deremer, R. K.; Fleming, K. N.; Hannaman, G. W.; Houghton, W. J.; Landoni, J. A.; Pfremmer, R. D.; Raabe, P. H.; Silady, F. A.; Vrouwes, J. H. (General Atomic Co., San Diego, Calif. (USA)). Dec 1975. Contract E(04-3)-167. vp. Dep. NTIS $7.60.

Included are detailed risk assessments of reheater leaks, loss of offsite power, and earthquakes. Research and development guidelines from AIPA are discussed.

28122 (GA-A-13779) GCR SAFETY PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 31 Jan 1976. Contract E(04-3)-167. 29p. Dep. NTIS $4.00.

The program covers development of safety and safety-related studies to better understand and more accurately define safety characteristics and safety margins of GCRs under postulated accident conditions. The work reported includes core seismic studies, high-temperature gas-cooled reactor (HTGR) accident initiation and progression analysis, the setting up of a reliability data bank, safety liaison with RRD-selected contractors, and safety research on core-released radioactivity and containment atmosphere response during postulated accident situations. (auth)

28123 (GEAP-5268) MONTHLY PROGRESS REPORT FOR JANUARY 1976 FOR THE HTGR SAFETY STUDIES FOR THE DIVISION OF SYSTEMS SAFETY, U. S. NUCLEAR REGULATORY COMMISSION. Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 11p. Dep. NTIS $4.50.

Progress is reported in the areas of thermal analysis of HTGR systems, axial mode spacing affects in flow distribution calculations, and performance calculations for the core auxiliary heat exchanger.

28124 (IRS-F-26) REPORTS ON THE RESEARCH PROJECTS IN THE FIELD OF REACTOR SAFETY SPONSORED BY THE FEDERAL MINISTRY OF RESEARCH AND TECHNOLOGY. Report Duration: 1st April to 30th June 1975. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Aug 1975. 379p. (In German). INIS.

With figs., tabs. and refs.

For the first time investigations on fast breeder reactors are added to those concerning the safety of light water reactors. (DE)

28125 (KFK-ISF-IB-6/75) SAFETY ASPECTS OF HIGH-TEMPERATURE REACTORS. Fassbender, J.; Katscher, W.; Meister, G.; Muench, E.; Wolters, J. P. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nukleare Sicherheitsforschung). Jul 1975. 38p. (In German). (AED-CONF-75-003-027). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

14 figs. Available from ZAED.

Following a description of the general features of the high-temperature reactor (HTR), the development of the HTR safety concept is illustrated by various hypothetical accidents (pressure relief, ingress of water into the primary loop, failure of the cooling system, release of fission products). More advanced systems such as the single-cycle system and the process heat reactor are discussed. (DE)

28126 (MRR-150) DETERMINATION OF HEAT TRANSFER AND THE CRITICAL HEAT FLUXES WITH RESPECT TO SPECIAL CONDITIONS IN THE COOLANT CHANNEL OF A PWR DURING COOLANT LOSS. Liesch, K. J.; Raemhild, G.; Hofmann, K. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Jun 1975. 164p. (In German). Dep. NTIS (US Sales Only) $6.75.

This report deals with the problems of the calculation of heat transfer coefficients and critical heat fluxes during the phase of depressurization of a loss-of-coolant accident. The special fluid and thermodynamic processes within the core region make the calculation more difficult and inaccurate. Therefore an attempt has been made, to calculate heat transfer coefficients and critical heat fluxes with steady state correlations inside the given validity ranges too. Since the calculation of the heat transfer coefficients shows rather good results, the calculation of the critical heat fluxes is only acceptable within the small validity ranges of the correlations. The purpose of this report is not to discuss, whether the applicated correlations can be used for the calculation of heat transfer coefficients and critical heat fluxes under nonsteady conditions or how good they fit experimental data, but it should give a possibility for a first estimation of the magnitude of both the heat transfer coefficient and the critical heat flux.

28127 (ORNL-5102) ZIRCONIUM METAL-WATER OXIDATION KINETICS. I. Thermometry. Cathcart, J. V.; McElroy, D. L.; Pawel, R. E.; Perkins, R. A.; Williams, R. K.; Yurek, G. J. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 69p. Dep. NTIS $6.00.

A description is given of the thermometry techniques used in the Zirconium Metal–Water Oxidation Kinetics Program. Temperature measurements in the range 900 to 1500°C are made in three experimental systems: two oxidation apparatuses and the annealing furnace used in a corollary study of the diffusion of oxygen in beta-Zircaloy. Carefully calibrated Pt vs Pt–10 percent Rh thermocouples are employed in all three apparatuses, while a Pt–6 percent Rh vs Pt–30 percent Rh thermocouple and an optical pyrometer are used in addition in the annealing furnace. Features of the experimental systems pertaining to thermocouple installation, temperature control, emf measurements, etc. are described, and potential temperature-measurement error sources are discussed in detail. The accuracy of the temperature measurements is analyzed.

28128 (ORNL-NSIC-120) HYDROGEN CONSIDERATIONS IN LIGHT-WATER POWER REACTIONS. Keilholtz, G. W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 355p. Dep. NTIS $15.00.

A critical review of the literature now available on hydrogen considerations in light-water power reactors (LWRs) and a bibliography of that literature are presented. The subject matter includes mechanisms for the generation of hydrogen-oxygen mixtures, a description of the fundamental properties of such mixtures, and their spontaneous ignition in both static and dynamic systems. The limits for hydrogen flammability and flame propagation are examined in terms of the effects of pressure, temperature, and additives; the emphasis is on the effects of steam and water vapor. The containment systems for pressurized-water reactors (PWRs) and boiling-water reactors (BWRs) are compared, and methods to control hydrogen and oxygen under the conditions of both normal operation and postulated accidents are reviewed. It is concluded that hydrogen can be controlled so that serious complications from the production of hydrogen will not occur. The bibliography contains abstracts from the computerized files of the Nuclear Safety Information Center. Key-word, author, and permuted-title indexes are provided. The bibliography includes responses to questions asked by the U. S. Nuclear Regulatory Commission (NRC) which relate to hydrogen, as well as information on normal operations and postulated accidents including generation of hydrogen from core sprays. Other topics included in the ten sections of the bibliography are metal-water reactions, containment atmosphere, radiolytic gas, and recombiners.

28129 (ORNL-NSIC-123) NUCLEAR POWER: ACCIDENT PROBABILITIES, RISKS, AND BENEFITS. A Bibliography. (483 2000) Feb 1976. Contract W-7405-eng-26. 138p. Dep. NTIS $12.00.

This report is a selected listing of 396 documents pertaining to nuclear accident probability and nuclear risk. Because of the attention focused on these concepts by the recent (August 1974) publication of the draft of WASH-1400, "Reactor Safety Study," it is intended that this bibliography make conveniently available the existence of relevant literature on these concepts. Such an awareness will enhance an understanding of probability and risk as applied to nuclear power plants and is essential to their further development and/or application. This bibliography includes first a listing of the selected documents with abstracts and keywords, followed by three indexes: (1) keyword, (2) author, and (3) permuted title.

28130 (ORNL/TM-5279) QUARTERLY PROGRESS REPORT ON THE CREEPDOWN AND COLLAPSE OF ZIRCALOY FUEL CLADDING PROGRAM SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR OCTOBER–DECEMBER 1975. Hobson, D. O. (Oak Ridge National Lab., Tenn. (USA). Feb 1976. Contract W-7405-eng-26. 11p. Dep. NTIS $3.50.

The creepdown and collapse study on Zircaloy fuel cladding is concerned with the deformation behavior of cladding under normal and near-normal reactor operating conditions. Progress is re-

ported on two phases of the program: (1) collapse testing and (2) development and fabrication of deformation-monitoring equipment. Sufficient collapse testing has been done to begin the analysis of the test data. It is apparent that all three of the independent variables used in this study (pellet-to-pellet gap, pellet-to-cladding gap, and temperature) play major roles in the collapse phenomenon. Tentative trends are presented but they constitute an insufficient basis for the quantitative formulation of a collapse model at this time. The instrumentation for deformation monitoring has been developed and provision has been made for automatic control of the data gathering system and for protection of the monitoring coils from damage caused by collapse of the specimen tube.

28131 (PB-240749) EVALUATION OF THE PEBBLE SPRINGS NUCLEAR POWER PROJECT FOR NON-RENEWABLE RESOURCES. Cole, D. L. (Portland General Electric Co., Oreg. (USA)). 26 Feb 1975. 24p. (PGE-2008). NTIS $3.75.

Prepared by Oregon Univ., Eugene. Museum of Natural History.

A study which evaluated the site of the Pebble Springs Nuclear Plant for historic, archaeological, and prehistoric resources in August 1974 is described. The study included a field survey, test excavations, and laboratory analysis. (GRA)

28132 (PPSP-CEIR-1) POWER PLANT CUMULATIVE ENVIRONMENTAL IMPACT REPORT. (Maryland Dept. of Natural Resources, Annapolis (USA)). Sep 1975. 200p. Department of Natural Resources, Annapolis, MD.

Objectives of the siting program are to provide adequate electric energy at reasonable cost, to improve environmental quality, and to protect natural resources. Some topics considered are electrical demand and consumption in Maryland; electrical power generation and power plant siting; airborne effects of power plants; aquatic impact; radiological effects of nuclear power plants; and social and economic considerations. (HLW)

28133 (SAAS-189) MEASURES OF RADIATION PROTECTION IN THE OPERATION OF NUCLEAR POWER PLANTS IN THE GERMAN DEMOCRATIC REPUBLIC. Richter, D.; Schreiter, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Nov 1975. 28p. (In German). Dep. NTIS (US Sales Only) $4.00.

A survey is given on the provisions concerning (a) radiation protection at nuclear power plants in the GDR including the instructions applying within the plant, (b) the organization of radiation protection services, and (c) the measures of radiation protection surveillance inside and outside the plant during operation. (auth)

28134 (SAND-75-0567) EXPERIMENTAL FAST REACTOR SAFETY RESEARCH PROGRAM. Quarterly Report, July–September 1975. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 76p. Dep. NTIS $9.00.

Research progress is reported for the following tasks: prompt burst excursion experiment, debris bed studies, material motion detection, molten fuel pool studies, and equation-of-state studies of reactor fuels. (JWR)

28135 (SAND-75-6102) POST-ACCIDENT HEAT REMOVAL "INFORMATION EXCHANGE". Plein, H. G.; Carlson, G. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 13p. (CONF-751140-2). Dep. NTIS $3.50.

From meeting on post-accident heat removal information exchange; Albuquerque, New Mexico, USA (13 Nov 1975).

The in-core molten pool experiments are designed to produce a pool of fission heated LMFBR-type fuel material, characterize temperature and flow patterns of such pools, and evaluate the barrier melt-through potential of the molten UO_2. The first experiments, to be conducted this fiscal year in the Annular Core Pulse Reactor, will be uncomplicated and multiply-contained to prove containment design and to provide initial information on fission heated molten pool characteristics. Concurrent with the in-core experiments, high temperature ultrasonic techniques are being developed to measure UO_2 temperatures up to and above the melting point for use in later more definitive experiments scheduled for FY77. (auth)

28136 (SL-TR-1(Rev. 1)) QUALITY ASSURANCE PROGRAM. (Sargent and Lundy, Chicago, Ill. (USA)). 30 Jan 1976. 95p. Sargent and Lundy, Chicago, IL.

Management commitments and policies on quality assurance are stated. Quality assurance requirements are established for the design and procurement phases of construction of a nuclear power plant. This report has been prepared in accordance with the guidance and requirements of Regulatory Guide 1.70.6, Additional Information, Quality Assurance During Design and Construction. The criteria in 10CFR50 Appendix B, Quality Assurance Criteria for Nuclear Power Plants have been individually addressed as each will or may be applicable on a specific project. (auth)

28137 (WCAP-7588(Rev.1-A)) EVALUATION OF THE ROD EJECTION ACCIDENT IN WESTINGHOUSE PRESSURIZED WATER REACTORS USING SPATIAL KINETICS METHODS. Risher, D. H. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jan 1975. 124p. Westinghouse Electric Corp., Pittsburgh, PA.

The consequences of a rod ejection accident are investigated in relation to the latest, high power density Westinghouse reactors. Limiting criteria are presented, based on experimental evidence, and if not exceeded these criteria will ensure that there will be no interference with core cooling capability, and radiation releases, if any, will be within the guidelines of 10CFR100. A basis is presented for the conservative selection of plant parameters to be used in the analysis, such that the analysis is applicable to a wide range of past, present, and future reactors. The calculational method employs a one-dimensional spatial kinetics computer code and a transient fuel heat transfer computer code to determine the hot spot fuel temperature versus time following a rod ejection. Using these computer codes, the most limiting hot channel factor (which does not cause the fuel damage limit criteria to be exceeded) has been determined as a function of the ejected rod worth. By this means, the limit criteria have been translated into ejected rod worths and hot channel factors which can be used effectively by the nuclear designer and safety analyst. The calculational method is shown to be conservative, compared to the results of a three-dimensional spatial kinetics analysis. (auth)

28138 (WCAP-8290(Add.1)) TEMPERATURE SENSITIVITY STUDY OF SINGLE ROD BURST TESTS. Burman, D. L.; Kuchirka, P. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Nov 1975. 39p. Westinghouse Electric Corp., Pittsburgh, PA.

A temperature sensitivity study of single rod burst tests has quantitatively defined temperature measurement errors due to three independent sources. Two of the three sources of temperature measurement error have proven to be significant. The significant error sources were pellet eccentricity producing a circumferential temperature gradient and external atmosphere cooling of uninsulated thermocouple leads. An adjustment of the previously reported burst temperature curve, based upon the analysis of this study, has resulted in raising the burst temperature versus pressure curve by approximately 100^0F. (auth)

28139 HAZARDS OF NUCLEAR FISSION POWER AND THE CHOICE OF ALTERNATIVES. Edsall, J. T. (Harvard Univ., Cambridge, MA). Environ. Conserv.; 1: No. 1, 21-30(Spr 1974).

Energy needs and the hazards of meeting these needs with nuclear power are discussed. The hazards of uranium mining, current reactor operations, the breeder reactor, radioactive wastes, and theft and sabotage are described. Alternative sources of energy and modes of energy conservation are examined. (JWR)

28140 MONITORING CIRCUIT FOR REACTOR SAFETY SYSTEMS. Keefe, D. J. (to U.S. Energy Research and Development Administration). US Patent Application 555,330. Filed date 4 Mar 1975. 8p.

The ratio between the output signals of a pair of reactor safety channels is monitored. When the ratio falls outside of a predetermined range, it indicates that one or more of the safety channels has malfunctioned. (auth)

28141 FUEL-VAPOR GENERATION IN LMFBR CORE-DISRUPTIVE ACCIDENTS. Kirbiyik, M. Charlottesville, VA; Univ. of Virginia (1975). 175p. University Microfilms Order No. 75-22,150.

Thesis (Ph. D.).

Analytical models were developed for estimating bounding values of fuel-vapor generation and fuel-expansion work in an LMFBR core-disruptive accident. Models included thermodynamic time-independent expansion and a time-dependent hydrodynamic expansion (the FEXPAN code) in spherical geometry. Three parametric calculations using the models were made for specified core-disruptive accident conditions for FFTF. For a 100 $/sec, sodium-out, FFTF disassembly followed by expansion without fuel mixing, the FEXPAN calculations indicated that approximately 9 percent of the fuel vaporized when the sodium column hit the cover (at approximately 25 msec after disassembly) and that the spatial pressure distribution in the fuel bubble became uniform between 4 and 10 msec. The results show that the presence of sodium in the core significantly decreases the fuel-vapor generation as well as the fuel-expansion work. Fuel mixing and thermal equilibrium prior to expansion greatly reduces the amount of fuel vaporized and the work done by the fuel expansion. (Diss. Abstr. Int., B)

28142 TRENDS OF DEVELOPMENT IN ULTRASONIC TESTING IN CONNECTION WITH NUCLEAR REACTOR SAFETY PROBLEMS. Mundry, E.; Wuestenberg, H.; Neumann, E.; Kutzner, J.; Nabel, E. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany). Fachgruppe Zerstoerungsfreie Materialpruefung). Materialpruefung; 17: No. 10, 347-352(Oct 1975). (In German). (AED-CONF-75-179-003).

From lecture meeting on the Deutsche Gesellschaft fuer Zerstoerungsfreie Pruefverfahren e.V.; Berlin, F. R. Germany (6 May 1975). 12 figs.; 24 refs.

The use of the ultrasonic inspection methods corresponds widely to the increased need for safety in nuclear power plants. Means are described in which a sufficient defect detection probability for the ultrasonic inspection can be assured. In addition, methods and their development possibilities for the quantitative analysis of detected reflectors are presented. The specific advantages and disadvantages of mechanized inspection are discussed. The problem of training and formation of operators and specialists on NDT for the nuclear field is represented by a quantitative estimation of the development of the required manpower. (DE)

28143 ALUMINUM FUEL CHANNEL INSTALLED BY MISTAKE. IRS Kurz-Inf., Reihe B; 32: No. 2, 1-5(1975). (In German).

At the time of the 9th refuelling of the Kahl experimental reactor—a boiling-water reactor which has been in commercial use since 1961—an aluminum fuel channel was installed by mistake. Oxidation of the aluminum channel led to premature unlatching of a control rod. (DE)

28144 NEW ASPECTS OF RADIATION PROTECTION AND NUCLEAR SAFETY ANALYSIS; DEVELOPMENT OF SAFETY CONCEPTS AND SAFETY SYSTEMS. Pre-report on the Subject of Technical Meeting No. 5. Tscherner, M. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (F. R. Germany). Fachbereich Kerntechnik). Kerntechnik; 17: No. 9/10, 419-425(Sep 1975). (In German, English).

A survey of the results achieved in recent years in the development and codification of technical safety requirements in the areas of radiation protection and reactor safety is presented. This includes a review of the completed and of the still proceeding work on the formulation of assessment standards and on the specification of limit values for the emission of radioactive substances. In addition, a survey is presented of the state of the discussion on the integrity of the primary circuit of light water reactors and on the development of a protection against bursting, as well as of the state of the investigations relating to some of the most important safety installations such as the containment and the emergency core cooling system. The currently valid design specifications relating to the protection of nuclear power plants against external occurrences, and the most recent developments in the area of accident analysis are discussed. The results of the so-called Rasmussen study are briefly reported. (DE)

28145 DIE HERAUSFORDERUNG. Energie fuer die Zukunft – Gefahren und Moeglichkeiten. (The Challenge. Energy for the Future – Risks and Possibilities). Breuer, G. Muenchen, F. R. Germany; Bertelsmann (1975). 239p. (In German).

Following some introductory remarks on the present world energy situation, the risks of nuclear energy are examined. Some other unconventional energy sources and limits to growth are discussed. (DE)

28146 SAFETY ASPECTS OF NUCLEAR MERCHANT SHIPS. Pruschek, R. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany). Hauptabteilung fuer Entwicklung und Analysen). Atomkernenergie; 26: No. 3, 145-152 (1975).

15 figs.; 1 tab.; 16 refs. Revised paper presented at the Conference on nuclear merchant ship propulsion, New York, 18 May 1975.

The safety equipment of a nuclear merchant ship is, to a great extent, defined by postulated reactor and ship accidents. Examples of measures to cope with such accidents and to prevent undue environmental impact from abnormal ship operation are cited. The discussion is based upon the recent design of the Nuclear Container Ship NCS 80 carried out by the Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH (GKSS) and the industrial consortium INTERATOM/BREMER VULKAN. (DE)

28147 AUSLEGUNG VON KERNKRAFTWERKEN GEGEN SEISMISCHE EINWIRKUNGEN. T. 1. Grundsaetze 6/75. (Design of Nuclear Power Plants with Respect to Seismic Effects. Pt. 1. Principles 6/75). Koeln, F. R. Germany; Heymanns (1975). 4p. (In German). (KTA-2201(Pt. 1)).

The present nuclear guideline gives the fundamentals according to which a nuclear power plant should be designed against seismic effects. It is valid for all stationary nuclear power plants in the Federal Republic of Germany. Furthermore, it shall also apply analogously to the design of all other nuclear plants. (DE)

28148 ULTIMATE LOAD ANALYSIS. Schimmelpfennig, K. (Bochum Univ. (F. R. Germany). Inst. fuer Konstruktiven Ingenieurbau). Konstr. Ingenieurbau Ber.; No. 23, 36-48(1975). (In German). (AED-CONF-75-491-004).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 11 figs.; 9 refs.

A method of investigating ultimate load behavior of prestressed concrete pressure vessels is presented using a numerical continuum calculation and considering a general material law. Information about theoretical and experimental fundamentals is given and several selected examples of analysis are shown. Due attention is focussed on describing realistically fracture processes in construction members subjected to shear forces (vessel end slabs). (DE)

28149 ANALYSIS FOR SERVICE LOAD CONDITIONS. Hansson, V. (Bochum Univ. (F. R. Germany). Inst. fuer Konstruktiven Ingenieurbau). Konstr. Ingenieurbau Ber.; No. 23, 25-35(1975). (In German). (AED-CONF-75-491-003).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 21 figs.; 13 refs.

Service load conditions include loads resulting from construction and normal and abnormal operating conditions. The method of analysis must take account of stress fields in the vessel wall, that are variable in three dimensions, and of material behavior, that is dependent on time and temperature and that may be nonlinear. Methods of analysis, material characteristics, and loading conditions for design purpose are discussed with examples. (DE)

28150 DEVELOPMENT OF CONSTRUCTION TECHNOLOGY FOR NUCLEAR POWER PLANTS. Schnellenbach, G. (Bochum Univ. (F. R. Germany). Abt. fuer Bauingenieurwesen). Konstr. Ingenieurbau Ber.; No. 23, 9-16(1975). (In German). (AED-CONF-75-491-001).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 16 figs.

Stringent safety requirements for nuclear power plants create new technological problems in their construction. The development is influenced by the mode of operation of the respective reactors which leads to different construction styles of the reactor buildings. Accommodation of extraordinary load cases such as earthquake, airplane crash, and blast due to chemical explosions, requires additional treatment. Significant new problems arise for the prestressed concrete reactor pressure vessels and concrete containments, prestressed or reinforced. (DE)

28151 MODAL ANALYSIS OF DAMPED SYSTEMS FOR CALCULATING OSCILLATIONS OF STRUCTURES DUE TO EARTHQUAKE. Schildberg, K. (Bochum Univ. (F. R. Germany). Inst. fuer Konstruktiven Ingenieurbau). Konstr. Ingenieurbau Ber.; No. 23, 91-103(1975). (In German). (AED-CONF-75-491-009).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 6 figs.; 2 tabs.; 33 refs.

In the Federal Republic of Germany, buildings and components of nuclear power plants with high safety demands have to be designed for earthquake influences. Dynamic loads are considerably determined by damping effects. Based on modal analysis, several methods for formulating linear damping are compared. The accuracy of an approximate consideration of damping is checked by an example. (DE)

28152 ANALYSIS OF REINFORCED CONCRETE STRUCTURES SUBJECTED TO EXTREME DYNAMIC LOADS–AIRCRAFT IMPACT, BLAST, INTERNAL ACCIDENTS. Stangenberg, F. (Zerna – Schnellenbach, Ingenieursozietaet fuer Konstruktiven Ingenieurbau, Bochum (F. R. Germany)). Konstr. Ingenieurbau Ber.; No. 23, 82-90(1975). (In German). (AED-CONF-75-491-008).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 14 figs.; 4 refs.

Dynamic ultimate load analysis of reinforced concrete structures of nuclear power plants is dealt with. Nonlinear material behavior up to a defined point of dynamic strength is taken into account as realistically as possible. Examples are given for the response due to aircraft impact. Suggestions are made for the design against blast, internal pressure, and internal jet forces. (DE)

28153 FAILURE PROBABILITIES FOR REACTOR PRESSURE VESSELS DERIVED FROM FAILURE STATISTICS FOR PRESSURE VESSELS IN THE CONVENTIONAL FIELD. Boesebeck, K. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany). Abt. Auslegung). Tech. Ueberwach.; 16: No, 10, 281-284(Oct 1975). (In German).

A direct determination of the failure rates for reactor pressure vessels by statistical methods is not yet possible due to the

small number of boiler years. Therefore, an attempt has been made to obtain a failure rate for reactor pressure vessels by the following steps: (1) investigation of fault data on pressure boilers in the conventional field, (2) a grouping of the faults into various classes of failure, (3) comparison of construction, building, inspection and type of operation of the two different kinds of boiler from which the relative fault probabilities are derived, (4) determination of the failure probability for a reactor pressure vessel from the above three steps. With the help of American, English, and German failure data, the following rates for serious failures of pressure boilers were found: conventional pressure vessel $\lambda = 10^{-6}$/a to 10^{-4}/a, reactor pressure vessel $\lambda = 10^{-4}$/a. Failure probability rates of a reactor pressure vessel are important for a realistic quantitative estimate of the risk of nuclear power plants. (DE)

28154 THE THIRD AMENDMENT TO THE ATOM LAW. Haeusler, D. (Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (F. R. Germany). Fachausschuss Recht). At. Strom; 21: No. 9/10, 99-100(Sep 1975). (In German).

Acting on relevant reservations at the signing of the Paris Atom Compensation Agreement and the Brussels Reactor Ship Agreement, in the third amendment to the Atom Law the Atom Compensation Laws applicable within the state are matched to the agreements made. At the same time, on the basis of further reservations, the protection of victims is regulated more favorably than in convention law. (DE)

28155 A FUSE AND ITS APPLICATION TO THE MANUFACTURE OF AN EMERGENCY STOPPING DEVICE FOR NUCLEAR REACTORS. Brugeille, G.; Taulier, H. H. L. (to Electricite de France, 75 – Paris). French Patent 2,230,984/A/. 22 May 1973. 13p. (In French).

Description is given of a fuse for severing two parts from each other in case of an abnormal temperature rise and preventing creeping. The fuse comprise a first member for mechanically connecting two parts, and a second member normally out of contact with the first member. Whenever temperature rises above a given threshold, the second member melts and thus comes into contact with the first member, which induces either an exothermal reaction causing the first element to melt, or the formation of an alloy the melting point of which is lower than the above threshold. This can be applied to the manufacture of an emergency stopping device for nuclear reactors. (FR)

28156 EFFECT OF LIQUID COMPRESSIBILITY AND FINITE BOUNDARY CONDITIONS ON VAPOR EXPLOSIONS IN SPHERICAL GEOMETRY. Speis, T. P. College Park, MD; Univ. of Maryland (1975). 127p. University Microfilms Order No. 75-28,777.

Thesis (Ph. D.).

When materials at very high temperatures come in contact with colder liquids a vapor explosion may occur. In this work it is assumed that a vapor explosion takes place when high temperature molten nuclear fuel comes in contact with liquid sodium following the occurrence of a postulated nuclear reactor accident. In the characterization of the interaction dynamics and the quantification of a vapor explosion, a dominant role is played by the surrounding liquid constraint in resisting the expansion of the vapor explosion or mixing zone. This work presents the results of a systematic study of the effects of various modelings of the constraint—from a fully compressible model—on the dynamics of the vapor explosion or mixing zone. (Diss. Abstr. Int., B)

28157 LIGHT WATER REACTOR ACCIDENTS: A CONSISTENT ANALYSIS OF THE IMPORTANCE OF SPACE–TIME EFFECTS. Decher, U. Pittsburgh; Carnegie-Mellon Univ. (1975). 353p. University Microfilms Order No. 75-19,849.

Thesis (Ph. D.).

An analysis is made of several Light Water Reactor (LWR) accidents to determine the importance of space–time effects. A one-dimensional, two energy group neutronics model is used along with a feedback model which accounts for the major feedback characteristics of PWR and BWR cores. The use of a uniform kinetics model for both PWR and BWR reactors allows comparisons of these two systems to be made, in addition to comparisons of individual accidents. The one-dimensional model is applied to both the radial and axial directions for each accident to determine the dimension in which the space–time effect is important for a particular accident. A detailed breakdown is provided of the reactivity components during the evaluation of the transients, including contributions of spatial flux redistributions to the various components. In addition, the accuracy of the use of reactivity coefficients during accident analysis is discussed with respect to space–time behavior. (Diss. Abstr.)

28158 ESSENTIAL COMPONENTS OF SAFETY ANALYSIS REPORTS FOR NUCLEAR POWER PLANTS. Rosen, M. (International Atomic Energy Agency, Vienna). pp 141-147 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

The Safety Analysis Report represents the principal communication between the applicant for a license and the regulatory body. In many countries a Preliminary Safety Analysis Report is required at the preconstruction stage and a Final Safety Analysis Report at the pre-operation stage. Outlines of the general objectives and essential components of such reports are provided, and review by the regulatory body is described. (auth)

28159 INSTITUTE FOR REACTOR SAFETY (IRS) OF THE TECHNISCHE UEBERWACHUNGS-VEREINE eV; ITS HISTORICAL DEVELOPMENT AND PRESENT STATUS. Butz, H. P. (Inst. for Reactor Safety, Cologne). pp 169-204 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

The Institute for Reactor Safety, which was established in 1965 by agreement between 11 Technical Inspection Associations in the Federal Republic of Germany in order to provide expertise on reactor safety, plays a key role in safety assessments of nuclear installations at both the Federal and State levels. A detailed account is given of the Institute's development, organization, functions, and activities vis-a-vis the Federal and State authorities and the international level. The safety criteria for nuclear power plants, as approved by the Laender Committee for Nuclear Energy, have been included as an Annex. (auth)

28160 THIRD PARTY LIABILITY PROBLEMS CONNECTED WITH NUCLEAR INSTALLATIONS. Reyners, P. (OECD/NEA, Paris). pp 243-253 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

The nuclear liability regime was primarily established at the international level before adoption by domestic laws. The principles embodied in several international conventions to govern third party liability for nuclear damage are recalled. The status and scope of application of the conventions are reviewed. Further harmonization in view of their implementation is desirable and more ratifications will facilitate international trade in nuclear materials and equipment. The various international organizations involved in this field have an important role to play as was the case with respect to the elaboration of existing conventions more than a decade ago. (auth)

Reactor Theory and Calculation

Refer also to abstracts 27674, 27723, 27726, and 27762.

28161 (HEDL-SA-928-S) NUCLEAR DATA FOR CALCULATION OF RADIOACTIVITY EFFECTS. Schenter, R. E.; England, T. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 20 Feb 1975. Contract AT(45-1)-2170. 7p. (CONF-750607-51). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

LOCA analyses require nuclear data for decay heating calculations for short cooling times (t/sub c/ less than 1000 sec). These same data, however, are also applicable to problems involving longer cooling times and additional related studies using calculations of radioactivity effects associated with fast and thermal reactor systems. These include absorption buildup, waste disposal and fuel management, shielding (spectra), fuel integrity (fission gas content), and buildup of radiologically hazardous and toxic products. Three examples are given using these recently developed nuclear data files. The examples present calculational results and comparison with evaluations of integral experiments of decay heat, delayed and prompt neutron yields, and gamma-spectra for photoneutron production.

28162 (IAEA–169(Vol.1), pp 3 v.; v.1 p.51-82) THE IMPORTANCE OF FISSION PRODUCT NUCLEAR DATA IN THE PHYSICS DESIGN OF POWER REACTOR CORES. Tyror, J. G. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The effect of fission product poisoning on the in-core physics performance of fast and thermal reactors is discussed. The main impact is on fuel reactivity although differential effects associated with temperature and voidage are important as is the effect of Xe-135 on thermal reactor kinetics. The sensitivity of fission product captures to yield and cross section data is discussed. Target accuracies on fuel reactivity lifetime are set, and from these the associated requirements on fission product data are deduced. (auth)

28163 (IAEA-169(Vol.1), pp 3 v.; v.1 p.285-352) STATUS OF FISSION PRODUCT YIELD DATA FOR THERMAL REACTORS. Walker, W. H. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Fission products affect reactors in many ways. Calculations of all these effects depend on fission product yields and hence on their accuracy. The dependence on accuracy may be high, as in the case of neutron absorption in ^{135}Xe and fuel burnup determinations, or low, as in the case of total energy release or the average β-decay energy per fission. An assessment of the current status of fission product nuclear data from the practical rather than fundamental scientific viewpoint indicates a need for a set of chain yields for thermal fission of ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu, and an assessment of their uncertainties. Measured direct yields are not numerous enough to permit such a set. The main problem areas for both chain and direct yield measurements are noted. (auth)

28164 (IAEA-169(Vol.2), pp 3 v.; v.2 p.115-162) RESIDUAL POWER DUE TO FISSION PRODUCTS. Lott, M. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Various evaluations of the residual power emitted by the fission products of the main fissionable nuclides are compared among themselves and with experimental results. The consistency of the evaluations, which is of the order of 10%, is generally better than that of the corresponding experiments. Efforts should be made to improve the basic data, especially those on short-lived nuclides; to estimate the errors in evaluation arising from the errors in the basic data; and to improve the integral experiments qualitatively and quantitatively. (auth)

28165 (IAEA-169(Vol.3), pp 3 v.; v.3 p.21-39) EFFECT OF BURNUP AND FISSION PRODUCT NUCLEAR DATA ON FAST REACTOR STATIC AND DYNAMIC PARAMETERS. Ilberg, D.; Saphier, D.; Yiftah, S. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Fast reactor static and dynamic parameters of "clean" and 100,000 MWd/t cores were evaluated. The calculations were performed with five different fission product cross section sets. Results are presented.

28166 (IKE-6-64E) THE PROBLEM OF A DIGITAL SIMULATION OF Xe OSCILLATIONS IN POWER REACTORS. Elzmann, H. J. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Apr 1974. 79p. (In German). INIS.

22 refs.; with figs.

Xe-induced power oscillations are simulated in a pressurized water reactor. The coupled balance equation for the neutrons and the decay products iodine/xenon are decoupled via a quasi-stationary approach. The stationary multigroup diffusion equation is solved with a difference method. The whole model is realized with the aid of already existing modules of the reactor program system RSYST. Its basic usefulness is established. A further expansion of the method is discussed with the aim to develop rod drive programs for real reactors. (DE)

28167 (JUL-1222) OPTIMUM CONTROL OF XENON OSCILLATIONS IN LARGE POWER REACTORS. Hanke, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Angewandte Mathematik). Jul 1975. 173p. (In German). Dep. NTIS (US Sales Only) $6.75.

Thesis. Submitted to Technische Hochschule, Aachen.

The problem of the optimal control of Xenon oscillations is solved both as a minimization problem with an integral performance index and as a minimal time control problem. Results for the optimal control rod behavior and for the influence of the rod strength and the rod position are given for a one-dimensional slab reactor. A simple strategy is given, which is capable of attaining the calculated minimum.

28168 (JUL-1225) ON THE METHOD OF INTERVAL-DISTRIBUTION MEASUREMENT FOR REACTIVITY DETERMINATION IN NUCLEAR REACTORS. Grenz, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (F. R. Germany)). Jul 1975. 105p. (In German). INIS.

111 refs.; with figs. and tabs.

Interval-distribution measurement is a statistical analysis of the time intervals between consecutive counts of a neutron detector for the determination of reactivity and power of a multiplying system. The procedure, which represents an advantageous alternative to ROSSI-α-, FEYNMAN-α-, and P_0-experiments, is methodically analyzed. At first the theory of branching processes is developed for monoenergetic neutrons in a point-reactor model. By numerical variation of relevant parameters such as neutron source strength, detector sensitivity, or reactivity the favored range for interval-distribution measurements has been evaluated. An experimental setup and a computer program for data analysis were developed and experiments carried out at the SUR and ITR reactors. The constraints for successful measurements are given. Interval-distribution measurements are possible with errors less than 5% for reactivities below -0.2 \$ and neutron source strengths $s < 4/\Lambda$. (DE)

28169 (RT/FI-73-41) EXPERIMENTS ON THE USE OF Gd_2O_3 AS BURNABLE POISON FOR PWR. Final Project of Sample Irradiation in Siloe. Lepscky, C.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1973. 52p. (In Italian). INIS.

7 figs.; 8 tables.

The results are reported of calculations performed to define the set-up of the experiments conducted by nuclear ship program of CNEN in the SILOE reactor (CEA Grenoble), which consist of irradiating natural UO_2 samples containing Gd_2O_3 in different concentrations. (INIS)

28170 STABILITY ANALYSIS OF SPATIALLY DEPENDENT NONLINEAR REACTOR SYSTEMS. Mync, L. Blacksburg, VA; Virginia Polytechnic Inst. and State Univ. (1975). 106p. University Microfilms Order No. 75-23,709.

Thesis (Ph. D.).

The space-time behavior of a neutron distribution governed by nonlinear multigroup diffusion approximation is considered. Stability criteria for equilibrium states of various reactor feedback models are determined by the methods of Liapunov, semigroup, and comparison functions. Comparison of the three approaches are made with respect to applicability to various models as well as computational difficulties associated with the three methods. The models chosen serve as illustrative examples of stability analysis; they also complement the existing examples in literature. The primary objective of this work is to simplify computational difficulties by the use of generalized mean value theorem for functionals, and functions of several variables. The results are expressed in the form of a theorem for the semigroup method, where a necessary condition for asymptotic stability is proven. It is applied to the problem of xenon oscillations. The use of the generalized mean value theorem in connection with the method by comparison function is also shown to lead to computational simplification. The result is applied to two energy group reactor models with temperature feedback. A simple numerical example and a comparison of the three methods, together with their variations, is given. The results show that the proposed method of calculating stability conditions leads to more conservative conditions, that is, smaller domains of allowable perturbations. The calculational procedure is, however, simplified in that the equilibrium nonlinear problem does not have to be solved. (Diss. Abstr. Int., B)

28171 EXPERIMENTAL REACTOR PHYSICS. Profio, A. E. New York; John Wiley and Sons, Inc. (1976). 820p.

Neutronic experiments in moderators, subcritical assemblies, critical assemblies, and nuclear reactors are described, as well as the techniques of radiation measurements necessary to perform these experiments. Previously dispersed data from government reports, journal articles, and specialized monographs are codified. Original information drawn from the author's experience is included, especially on the pulsed source technique, spectrum measurements, research reactors, and exponential assemblies. The book provides the essential information for carrying out, analyzing, and understanding the experiments. Theory is kept to a minimum. Emphasis is placed on the physics of the situation, and the importance of estimating error as well as the mean value of a measured quantity. (auth)

28172 SPLINE INTERPOLATION IN A N-DIMENSIONAL DATA-BASE FOR NUCLEAR REACTOR CALCULATIONS. Havranek, M. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 190-192(1975).

An interpolation method for a cross-section data-base dependent on N physical parameters and used in reactor calculations is reported. It is assumed that the cross-section matrices on a primitive orthorhombic mesh in N-dimensional space of the physical parameters are known. The cross-section matrix corresponding to any point of the mesh volume is constructed using a local interpolation based on a tensor product of one-dimensional Hermite splines. The definition of the m-th Hermite interpolant H_{mx} in the N-dimensional case together with a certain error information is presented. As an application the solution of the system for H_{mx}, m = 1.2 is given. The results of the practical use for the fuel depletion calculation for the Kernkraftwerk Obrigheim (KWO) reactor is given. (DE)

28173 DATA STRUCTURES DESCRIBING THE DYNAMIC BEHAVIOR OF BURN-UP DATA FOR AUTOMATIC HANDLING IN A MODULAR SYSTEM. Wohland, H. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 193-194(1975).

The principles of the representation of dynamic data structures within the modular system RSYST-II are described. The identification of data blocks and data elements is carried out with the help of hierarchical data structures. Therefore, a simple formulation of complex burn-up problems is possible. The scheme of identification permits the user to define table functions simply. The consequent application of this scheme leads to a general generation and representation module for different data block types and to a data-structure independent programming of modules. (DE)

28174 TWO- AND THREE-DIMENSIONAL REACTOR PHYSICS CALCULATIONS WITH THE FINITE ELEMENT METHOD. Franke, H. P.; Sapper, E.; Schmidt, F. A. R. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 158-162(1975).

4 figs.; 3 tabs.; 14 refs. – Parts of theses submitted to the Stuttgart Univ. by Franke and Sapper.

Experiences with the Finite Element Method (FEM) are reported. Techniques to solve 2- and 3-dimensional diffusion problems in reactor physics by the FEM are compared. Accuracy and computing costs of the FEM are demonstrated by calculations for the IAEA benchmark problem for two and three dimensions. The results support further efforts to develop the method. It seems most promising to use the method for more complicated calculations in reactor physics. (DE)

28175 HIGHER-ORDER RELATIONSHIP BETWEEN EIGENVALUE SEPARATION AND STATIC FLUX TILTS. Beckner, W. D. Charlottesville, VA; Univ. of Virginia (1975). 187p. University Microfilms Order No. 75-22,122.

Thesis (Ph. D.).

Spatial kinetics phenomena in nuclear reactors, such as xenon-induced spatial flux oscillations, are currently being analyzed using the higher harmonic solutions to the static reactor balance equation. An important parameter in such an analysis is a global quantity called eigenvalue separation. It is desirable to be able to experimentally measure this parameter in power reactors in order to confirm design calculations. Since spatial distortions in the flux shape depend on the eigenvalue separation of the reactor, an attempt has been made previously to use this fact as a means of measuring the parameter. It was postulated that an induced flux distortion or "static flux tilt" could be measured and theoretically related to eigenvalue separation. Unfortunately, the behavior of experimental data did not exactly agree with theoretical predictions, and values of the parameter found using the original static flux tilt technique were consistently low. The theory has been re-evaluated here and the previously observed discrepancy eliminated. Techniques have been also developed to allow for more accurate interpretation of experimental data. In order to make the method applicable to real systems, the theory has been extended to two spatial dimensions; extension to three dimensions follows directly. Possible trouble areas have been investigated, and experimental procedures for use of the technique to measure the eigenvalue separation in power reactors are presented.

28176 GENERALIZED PADE AND CHEBYSHEV APPROXIMATIONS FOR POINT KINETICS. Hennart, J. P.; Barrios, B. T. (Instituto Politecnico National, Mexico City). Nucl. Sci. Eng.; 59: No. 2, 170-187(Feb 1976).

New methods of the Pade and Chebyshev type are applied to the solution of the point kinetics equations. A theoretical analysis is presented in an attempt to derive global approximations by opposition to the local ones that have been used up to now. It is shown that many of the techniques developed earlier for integrating stiff systems of ordinary differential equations are particular cases of this general formalism. Numerical studies are presented for various reactivity insertions. The results confirm the theoretical analysis and indicate the range of applicability of the methods presented. (auth)

28177 SENSITIVITY THEORY FROM A DIFFERENTIAL VIEWPOINT. Oblow, E. M. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 59: No. 2, 187-189(Feb 1976).

An alternate derivation of sensitivity functions in terms of functional derivatives is presented to interpret sensitivity results from a differential viewpoint. No reference is made in this approach to perturbations or variations in defining sensitivity functions so that they can be seen to be "exact" differential quantities. The differential approach should allow sensitivity methods to be applied more easily to simple model problems in the areas of shielding and core physics, since these problems can be analyzed in terms of functional derivatives. (auth)

Reactor Components and Accessories

Refer also to abstracts 25894, 26514, 26525, 26526, 26528–26530, 26535–26541, 26546–26548, 26553, 26556, 26574, 26596, 26748, 26755, 26759, 26764, 26770, and 26835.

28178 (AED-CONF-74-538-045) D-GUN COATINGS FOR NUCLEAR INDUSTRY. Schwarz, E. 1974. 5p. (In German). INIS.

From second international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

5 figs.; 1 tab.; 5 refs. Available from ZAED.

D-gun coating applications in helium- and sodium systems are discussed. Protective coatings eliminate self-welding problems on contact areas of steel materials and increase lifetime of guides, seal rings and pump components. (DE)

28179 (AED-CONF-74-538-050) AUTOMATIC REPAIR WELDING ON A NOT ACCESSIBLE SPOT IN THE REACTOR PRESSURE VESSEL. Guettler, R.; Meyer, W. (Kraftwerk Union A. G., Grosswelzheim (F. R. Germany)). 1974. 5p. (In German). INIS.

From second international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

10 figs.; 1 ref. Available from ZAED.

The development of a remote controlled welding machine and of the technology for repair of defected control rod connecting pieces of austenitic steel No. 4.550 in the reactor pressure vessel are described. (DE)

28180 (NP-20791) QUALITY ASSURANCE FOR SAFETY-RELATED STRUCTURES, SYSTEMS, AND COMPONENTS. (Sargent and Lundy, Chicago, Ill. (USA)). 12 Nov 1975. 39p. Sargent and Lundy Engineers, Chicago, IL.

The Sargent and Lundy Topical Report on Quality Assurance for safety-related structures, systems and components is presented. Management commitments and policies on quality assurance are stated. Quality assurance requirements are established for the design and procurement phases of construction of a nuclear power plant. (auth)

28181 (PB-238903) EFFECT OF GEOGRAPHICAL VARIATION ON PERFORMANCE OF RECIRCULATING COOLING PONDS. Thackston, E. L. (National Environmental Research Center, Corvallis, Oreg. (USA)). Dec 1974. 239p. (EPA-660/2-74-085). GPO.

The energy budget approach to cooling ponds has been outlined and applied to closed cycle, recirculating cooling ponds. Monthly average weather data from 88 stations throughout the U. S. were used to calculate equilibrium temperatures, heat exchange coefficients, and the average temperature of various sized ponds receiving the effluent from a standard power plant of 1000-mw capacity, both for average and extreme weather conditions. The data for each station is shown on a separate chart, and the variation of these results across the U. S. is depicted by a series of 38 maps of the U. S., with contours connecting equal values of the parameters. The results may also be used to estimate cooling pond performance for other sized power plants and other sized ponds. The maps disclose variations across the U. S., on a given date, of up to 55°F difference in pond temperatures. Increase of pond temperature over equilibrium is greater in winter than in summer. (auth)

28182 (RDT-F-1-2T(Rev.)(12-75)) PREPARATION OF SYSTEM DESIGN DESCRIPTIONS. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Development and Demonstration). Dec 1975. 24p. RSO.

A standard is presented which prescribes the purpose, scope, organization, and content of system design descriptions (SSD's), in order to promulgate a unified approach to their preparation and use by a project as the principal means to establish, describe, and control the individual system designs from conception and throughout the lifetime of the system. SDD's are comprehensive technical documents that specifically and completely define the design, including operation, maintenance, and reliability requirements, of individual systems which comprise a nuclear power plant or test facility. SDD's are prepared and maintained current by the responsible system designer and are the principal means of system design definition and control common to the designer and the other participating organizations responsible for the project. (auth)

28183 (RDT-F-8-7T(1-76)) TRANSPORTATION OF CRITICAL COMPONENTS AND EQUIPMENT. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Development and Demonstration). Jan 1976. 21p. RSO.

A standard is presented which covers recommended practices in the planning, coordination, and administration of shipments of critical components and equipment for nuclear facilities. The standard supplements and is additive to the rules and regulations of freight classifications and tariffs governing carriers and shipping, and has the purpose of minimizing the likelihood of physical damage or deterioration of critical components and equipment due to collision, upset, shock, vibration, corrosion, or other conditions of the transport environment. (auth)

28184 CAUSTIC STRESS CORROSION CRACKING OF INCONEL-600, INCOLOY-800, AND TYPE 304 STAINLESS STEEL. Theus, G. J. (Babcock and Wilcox Co., Alliance, OH). Nucl. Technol.; 28: No. 3, 388-397(Mar 1976).

High-temperature electrochemical tests have resulted in the stress corrosion cracking of Inconel-600 and Incoloy-800 (registered trademarks, International Nickel Company), and Type 304 stainless steel in caustic solutions. Results show that stress corrosion cracking of these alloys can be prevented or accelerated by varying their electrochemical potential. To a certain extent, the same effect can be achieved by altering the gas atmosphere above the test solution from a pure nitrogen cover gas to a mixture of 5 percent H_2 and 95 percent N_2. The effect of the cover gas can then be negated by adjusting the specimen's electrochemical potential either to cause or to inhibit stress corrosion cracking. Some specifics of the test results reveal that in deoxygenated caustic solutions, Inconel-600 cracks intergranularly at mildly anodic potentials; Incoloy-800 cracks intergranularly at reduced potentials (at or near the open circuit potential) and integranularly at highly oxidizing potentials; and cracking is mixed (transgranular/intergranular) for Type 304 stainless steel at or near the open circuit potential. The severity of cracking for both Inconel-600 and Incoloy-800 in deoxygenated caustic solutions is reduced by giving the materials a simulated post-weld heat treatment (1150°F for 18 h). Test results on Inconel-600 show that high-carbon (0.06 percent) material cracks less severely than low-carbon (0.02 percent) material, in both the simulated post-weld heat-treated condition and the mill-annealed condition. (auth)

28185 USE OF DISSOCIATING GASES AS WORKING MEDIA FOR THERMODYNAMIC CYCLES. Beer, H.; Rodi, W.; Rieger, H. (Univ., Stuttgart). Forsch. Ingenieurwes.; 40: No. 6, 186-191 (1974). (In German)

High effective heat conductivity and high specific heat capacity make dissociating gases appear suitable as working media for thermodynamic cycles. A hot gas process with dissociating nitrogen tetraoxide and a nuclear reactor as heat source was compared with respect to the thermal efficiency with other non-dissociating media. (tr-auth)

28186 PIPE GRIPPER. Moyers, S. M. (to U. S. Energy Research and Development Administration). US Patent 3,925,874. B23P19/02. 16 Dec 1975. Filed date 9 Jul 1974. 4p.

PAT-APPL-486,924.

A device for gripping the exterior surface of a pipe or rod is described which has a plurality of wedges, each having a concave face which engages the outer surface of the pipe and each having a smooth face opposing the concave face. The wedges are seated on and their grooved concave faces are maintained in circular alignment by tapered axial segments of an opening extending through a wedge-seating member. The wedges are allowed to slide across the tapered axial segments so that such a sliding movement acts to vary the diameter of the circular alignment.

28187 TRANSITION SECTION FOR ACOUSTIC WAVEGUIDES. Karplus, H. H. B. (to U.S. Energy Research and Development Administration). US Patent 3,915,018. G01H3/10. 28 Oct 1975. Filed date 21 Nov 1974. 12p.

PAT-APPL-526,038.

A means of facilitating the transmission of acoustic waves with minimal reflection between two regions having different specific acoustic impedances is described comprising a region exhibiting a constant product of cross-sectional area and specific acoustic impedance at each cross-sectional plane along the axis of the transition region. A variety of structures that exhibit this feature is disclosed, the preferred embodiment comprising a nested structure of doubly reentrant cones. This structure is useful for monitoring the operation of nuclear reactors in which random acoustic signals are generated in the course of operation.

28188 MEETING: TECHNOLOGICAL RELIABILITY. Vetterkind, D. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F. R. Germany). Hauptverwaltung). Elektrotech. Z., A; 96: No. 9, K121-K125(Sep 1975). (In German).

From conference on technical reliability; Nuremberg, F. R. Germany (26 May 1975). 4 figs.; 35 refs.

The central issue of the meeting was reliability and its economic significance. About 35 lectures and technical contributions were arranged in groups in accordance with the subjects of safety, reliability of functioning maintenance, and availability efficiency. The reliability of nuclear reactor components is an important factor in the economy of the FRG. Recent and future progress could and can only be achieved by means of mathematical quantification of reliability and safety, the use of standardized terms, and better regard to the human unreliability. (DE)

28189 DESIGN AND CONSTRUCTION TECHNICS. Wrage, S. (Zerna – Schnellenbach, Ingenieursozietaet fuer Konstruktiven Ingenieurbau, Bochum (F. R. Germany)). Konstr. Ingenieurbau Ber.; No. 23, 49-59(1975). (In German). (AED-CONF-75-491-005).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 21 figs.; 14 refs.

A series of unorthodox problems arises with design and construction of prestressed concrete pressure vessels. Of special interest are the prestressing systems, arrangement of reinforcement, and use of precast elements. Conventional methods of prestressing are not applicable because of extreme loads. The arrangement of reinforcement causes problems especially in zones of high stresses where in addition to the reinforcing bars liner cooling systems, their feeding pipes, and liner anchors are concentrated. (DE)

28190 PRESTRESSED AND REINFORCED CONCRETE CONTAINMENTS. Analysis – Design – Construction. Schnellenbach, G. (Bochum Univ. (F. R. Germany). Abt. fuer Bauingenieurwesen). Konstr. Ingenieurbau Ber.; No. 23, 70-81(1975). (In German). (AED-CONF-75-491-007).

From meeting on nuclear constructional engineering; Essen, F. R. Germany (24 Feb 1975). 10 figs.; 5 tabs.; 10 refs.

Nuclear reactors performing in the German Federal Republic to date were supplied with steel containments. The first reinforced concrete and prestressed concrete containments, respectively, are going to be used for the nuclear power plants Kalkar and Gundremmingen (KRB II) as well as for the HTR plant. The problems connected with analysis, design, and construction of these structures are discussed. (DE)

28191 MINIATURE IONIZATION CHAMBERS AND NEUTRON BETA DETECTORS FOR NEUTRON FLUX MEASUREMENTS IN REACTOR CORES. Tsekouras, A. (Kraftwerk Union A. G., Offenbach (F. R. Germany). Hauptbereich Reaktortechnik); Haller, P. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Reaktortechnik). Arch. Tech. Mess. Messtech. Prax.; No. 472, 77-80 (May 1975). (In German).

Neutron flux detectors in the core must be so small that they can be assumed as points compared to the core dimensions. Furthermore, they must be able to withstand the condition inside the reactor core (reactor radiation, temperature, pressure) over a long time period. If the detectors are to be included in the reactor safety system, they must have a small time constant. For measuring technical and economical reasons, an attempt is made to guarantee a ratio of the information signal to the interference background of 10 : 1 over a service life of 3 to 4 years. The detectors fulfilling these requirements are the miniature ionization chambers and the neutron beta-detectors. (DE)

28192 PROBLEMS OF HEAT TRANSFER, PRESSURE LOSS AND FLOW STABILITY IN HIGHLY THERMALLY STRESSED STEAM GENERATOR TUBES. Gilli, P. V.; Edler, A.; Halozan, H.; Schaup, P. (Technische Hochschule, Graz (Austria). Inst. fuer Dampfkesselbau, Reaktortechnik und Waermewirtschaft). VGB Kraftwerkstech.; 55: No. 9, 589-600(Sep 1975). (In German).

Modern power stations — conventional steam power plants as well as nuclear power stations — are characterized by the advance

of the flow principle and by an increase in block sizes up to an electric power of more than 1000 MW. For physical and economical reasons, this led to an intensified heat flow which in the case of nuclear power stations is also due to the properties of the heating medium, i.e., pressurized water, high-pressure gas, or liquid metal, while the numerical increase in oil heatings in conventional power plants entrailed high peak loads. These increased heat flows, which may reach about 1000 kW/m^2 in the steam generators of nuclear power stations, may under certain conditions exceed the critical thermal load, i.e., the threshold of film boiling or evaporation. The hydraulic stability of the two-phase flow, for whose calculation requires data on the two-phase pressure drop, plays an important role. Some knowledge on the two-phase pressure drop is also necessary for an exact design of the steam generator tubes with vaporization heat flow. (DE)

28193 TWO PHASE FLOW PROBLEMS IN POWER STATION BOILERS. Firman, E. C. (Central Electricity Research Labs., Leatherhead (UK)). pp 65-77 of Heat Exchangers. 9. International Meeting, Paris, 16-18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974).

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

Some of the waterside thermal and hydrodynamic phenomena relating to design and operation of large boilers in central power stations are outlined. The principal features of conventional and nuclear drum boilers and once-through nuclear heat exchangers are described. This is followed by discussion of the relevant physical phenomena and problems which arise. For example, the problem of steam entrainment from the drum into the tubes connecting it to the furnace wall tubes is related to its effects on circulation and possible mechanisms of tube failure. Other problems concern the transient associated with start-up or low load operation of plant. The requirement for improved mathematical representation of steady and dynamic performance is mentioned together with the corresponding need for data on heat transfer, pressure loss, hydrodynamic stability, consequences of deposits, etc. The facilities employed by the C.E.G.B. and the specific studies being made on them are described: these range from field trials on operational boilers to small scale laboratory investigations of underlying two phase flow mechanisms and include high pressure water rigs and a freon rig for simulation studies. (FR)

28194 DIGITAL AND HYBRID SIMULATION OF HEAT EXCHANGERS FOR THERMAL OR NUCLEAR POWER PLANTS. Marsot, G.; Perrin, M.; Hery, M.; Marion, B. (Electricite de France, 75 – Paris. Direction des Etudes et Recherches). pp 545-573 of Heat Exchangers. 9. International Meeting, Paris, 16-18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974). (In French).

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

Electricite de France has been using extensively numerical or hybrid simulation in the study of heat exchanger problems. The hybrid methods were used for studying the EDF gas cooled reactors, then the heat exchangers of the Phenix fast neutron reactor project. The analog technique used in the beginning (with continuous representation of time and discrete representation of space) was later dropped in favor of a different approach (continuous representation of space and discretization of time). In the meanwhile a numerical code was being developed. The most interesting aspects of this approach are discussed: numerical method adopted and stability problems; use of a unique set of subroutines for monophasic and diphasic (including the possibility of slip) flow application of the model to the Ambes (125MW) and Porcheville B1 (600MW) power plants. (FR)

28195 TESTS OF AN EXPERIMENTAL STEAM GENERATOR HEATED BY SODIUM-POTASSIUM FLOW. Robin, M. G.; Duchatelle, L.; de Nucheze, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). pp 531-544 of Heat Exchangers. 9. International Meeting, Paris, 16-18 June 1971. Veron, M. (ed.). Paris, France; Institut Francais des Combustibles et de l'Energie (1974). (In French).

From international meeting on heat exchangers; Paris, France (16 Jun 1971).

The first boiler heated by liquid alkaline metal flow installed at the C.E.A. Heat Test Centre at Grand-Quevilly, near Rouen, was a double-walled 5MW model fed with water at 220°C and producing superheated steam at 545°C and at an effective pressure of 125 bar. From 1965 to 1967, in the course of more than 8,000 hours of operation under varied conditions (specific water flow rates between 110 and 1,200 kg/sq.m./sec., steam pressures of 85 and 125 bar), some 200 results of stationary operating conditions were obtained. These were compared with calculated predictions. The heat transfer results and pressure loss values are discussed. (FR)

28196 A THROUGH-PASSAGE VALVE WITH CLOSING MEMBERS. Alanquant, C.; Perraguin, J.; Pouligny, J. (to Segault S.A., 75 – Paris (France)). French Patent 2,218,515/A/. 20 Feb 1973. 19p. (In French).

This valve, provided with two floating closing members, is characterized in that it comprises a median plate, parallel to said members, mounted inside the valve body and integral therewith, said plate comprising a bore for the passage of the rod of a control device therethrough, a passage orifice aligned with conduits opening into said body and along which is movable a traverse level controlled by said rod, and two seats for the closing members, these seats being mounted on the two faces of the median plate at the extremities of the passage orifice. This can apply to high pressure fluid circuits and, contingently, to high temperature fluid circuits. (FR)

28197 QUANTITATIVE ESTIMATE OF THE EFFECT OF CHLORIDE CONCENTRATION ON THE STABILITY OF AUSTENITIC STAINLESS STEELS UNDER THE OPERATING CONDITIONS OF A BOILING REACTOR. Gerasimov, V. V.; Andreeva, G. V. Sov. At. Energy (Engl. Transl.); 38: No. 4, 315-316(Apr 1975).

Translated from At. Energ.; 38: No. 4, 250-251(Apr 1975).

In the boiling reactors of seacoast atomic power stations, owing to the presence of oxygen and chlorides in the medium, there may arise conditions which facilitate the development of corrosion in austenitic stainless steels under stress. Dangerous Cl^- concentrations are evaluated quantitatively on the basis of present-day ideas about the mechanism of corrosion under stress and of the electrochemical reactions leading to the breakdown of the passive state. (auth)

28198 SCALE EFFECT IN THE EXPLOSIVE DESTRUCTION OF WATER-FILLED VESSELS. Tsypkin, V. I.; Kleshchevnikov, O. A.; Shitov, A. T.; Mineev, V. N.; Ivanov, A. G. Sov. At. Energy (Engl. Transl.); 38: No. 4, 317-318(Apr 1975).

Translated from At. Energ.; 38: No. 4, 251-252(Apr 1975).

A description is given of the investigation of the destruction of water-filled vessels when a charge of an explosive substance explodes inside the vessels. The explosive charge, a sphere of diameter d, was placed at the center of the vessel, and the explosion was initiated from the center. High-speed motion-picture photography and tensometry and a coordinate grid on the external surface of each vessel were used to record the deformation and destruction of the vessels. The results obtained agree with the results of investigations on the strength of steel vessels and tubes not filled with water when explosive charges are set off inside them and also support the view that scale has an effect on the strength characteristics of the vessels. These results must be taken into consideration in the evaluation of accidents in chemical and nuclear reactors. (auth)

Reactor Fuels

28199 (IAEA-169(Vol.1), pp 3 v.; v.1 p.191-212) IMPORTANCE OF FISSION PRODUCT NUCLEAR DATA FOR SAFEGUARDS TECHNIQUES. Weitkamp, C. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

66 refs.

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The role of fission product nuclear data has been reviewed for the three important categories of safeguards techniques based upon the fission process: fresh fuel assay, nondestructive measurement of spent fuel by gamma spectrometry, and correlations of stable fission products with characteristic data of the fuel and its history.

28200 (IAEA-169(Vol.1), pp 3 v.; v.1 p.213-223) IMPORTANCE OF FISSION PRODUCT NUCLEAR DATA FOR FUEL HANDLING. Merz, E.; Laser, M. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

A survey of desirable additional nuclear data is presented. The inauguration of an internationally accessible nuclear data library is recommended with the task of not only compiling all published data, but especially evaluating the most reliable ones. Delivery of such selected data to users in a common computer media would be additionally useful. (auth)

28201 (IAEA-169(Vol.3), pp 3 v.; v.3 p.55-56) FNDP NEEDED FOR NON-DESTRUCTIVE BURNUP DETERMINATION. Debertin, K.; Ramthun, H. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

There is a need of more accurate fission product nuclear data for the non-destructive burn-up determination by means of γ-ray spectrometry and post-irradiation calorimetry. Mean β-ray energies and γ-ray emission probabilities of medium- and long-lived fission products are primarily required. (auth)

28202 (IAEA-169(Vol.3), pp 3 v.; v.3 p.57-58) BURNUP DETERMINATION BY NEUTRON TRANSMISSION. Priesmeyer, H. G. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

A method for non-destructive determination of the residual heavy atom content of irradiated fuel is briefly described. Initial studies for ^{235}U are based on the neutron resonance absorption at 8.78, 11.67 and 12.4 eV. This method is applicable to highly irradiated material because of the absence of strong fission product resonances at these energies. (auth)

28203 (IAEA-169(Vol.3), pp 3 v.; v.3 p.59-69) IMPORTANCE OF FISSION PRODUCT NUCLEAR DATA IN BURNUP DETERMINATION. Robin, M.; Bouchard, J.; Frejaville, G.; Vidal, R.; Hageman, R. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Measuring the content of ^{148}Nd is the most exact method of determining burn-up. A useful supplement to this method is the relative, but non-destructive, measurement of the contents of gamma-emitting nuclides resulting from fission. A good knowledge of the fission yields is necessary to interpret the results of analysis of the ^{148}Nd content. Results recently obtained in France for thermal neutron fission of ^{235}U and ^{239}Pu and for fast neutron fission of ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu and ^{241}Pu are presented.

28204 (IAEA-169(Vol.3), pp 3 v.; v.3 p.71-82) MEASUREMENT OF BURNUP OF IRRADIATED FUEL BY ANALYSIS OF GAMMA-RAY SPECTRA. Tasaka, K.; Sasamoto, N. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The reliability of fission product nuclear data are examined through the burnup measurement of the irradiated fuel of JRR-4 by analyzing the gamma-ray spectra of small samples which were cut from the MTR-type fuel plate. The fuel assembly was irradiated for about 4 years in the core and the gamma-ray spectra were measured using a Ge(Li) detector after cooling for 522 days.

It is pointed out through the analysis that improved data on the gamma-ray abundance of each FP nuclide are necessary to get better accuracy of a burnup measurement. (auth)

28205 (IAEA-169(Vol.3), pp 3 v.; v.3 p.83-90) PROBLEMS ENCOUNTERED IN BURNUP DETERMINATION OF OXIDE FUEL SPECIMENS WITH A HIGH ROD POWER. Wertenbach, H. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

An indication is given of the restrictions with respect to the accuracy of burnup analysis through migration of the fission products and the heavy atoms and of errors produced in the conversion of atom percent of burnup into MWd/tonne. It is not considered necessary to achieve errors lower than 1 - 2% for the fission yields of U-235 and Pu-239 and of 2 - 3% for Pu-241 both in the thermal and in the fast spectra. (auth)

28206 (IAEA-169(Vol.3), pp 3 v.; v.3 p.91-101) INFLUENCE OF FISSION PRODUCT NUCLEAR DATA UNCERTAINTIES ON A METHOD OF PLUTONIUM DETERMINATION FROM THE BURNUP DATA IN IRRADIATED NUCLEAR FUEL. Schaechter, L.; Hacman, D.; Mot, O. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

A method regarding the possibility to determine the plutonium content in an irradiated nuclear fuel by using burn-up data is presented. The method has been applied to fuel irradiated in the Bucharest VVR-S reactor at 10% burn-up after 600 days of cooling time. The plutonium determination is quoted to be in error by 7%. A study of the influence of the uncertainty, introduced by the FPND, on the final results is carried out. It was found that a half-life error of 1.5% contributed 1.8% uncertainty to the final results. (auth)

28207 (IAEA-169(Vol.3), pp 3 v.; v.3 p.105-109) CONTROL OF FISSIONABLE MATERIAL BY MEANS OF DELAYED NEUTRONS. Maksyutenko, B. P.; Tarasko, M. Z. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

Translation of report FEI-370.

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

The authors propose a new method of identifying fissionable materials or determining the percentage of them present in a mixture; the new method, which replaces the normally applied six-group analysis of the delayed neutron decay curve, is based on representation of the decay curve as a continuous distribution of the precursors of the delayed neutrons relative to their half-lives. (auth)

28208 (IAEA-169(Vol.3), pp 3 v.; v.3 p.111-119) FISSION PRODUCT NUCLEAR DATA AND NONDESTRUCTIVE ASSAY SYSTEMS OF NUCLEAR MATERIALS. Gozani, T. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

A concise list of passive and active nondestructive assay (NDA) techniques for nuclear material is presented. Development, design, and implementation of NDA techniques are shown to be dependent on fission product nuclear data (FPND) to a varying degree. Areas where some additional work would be desirable are identified. (auth)

28209 (IAEA-169(Vol.1), pp 3 v.; v.1 p.163-190) FISSION PRODUCT NUCLEAR DATA REQUIREMENTS FOR THE DETERMINATION OF NUCLEAR FUEL BURNUP: A REVIEW. Maeck, W. J. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Proceedings of a panel organized by the IAEA and held in Bologna, 26-30 November 1973. (International Atomic Energy Agency, Vienna (Austria)).

Specific needs for improved fission product nuclear data for the determination of nuclear fuel burnup are reviewed. The various techniques for measuring burnup, both destructive and non-destructive, are discussed with regard to applicability and to fission product nuclear data requirements. The highest priority fission product nuclear data requirements are for fast reactor fission yields as a function of neutron energy and for decay scheme data for radionuclides used as burnup monitors. New data showing the variation of fission yields with neutron energy and the need to associate all fast fission yields with a well defined spectral index are given. (auth)

28210 FUEL OR IRRADIATION SUBASSEMBLY. Seim, O. S.; Hutter, E. (to U.S. Energy Research and Development Administration). US Patent 3,928,126. G21C3/02. 23 Dec 1975. Filed date 9 Jul 1974. 4p.

PAT-APPL-486,787.

A subassembly for use in a nuclear reactor is described which incorporates a loose bundle of fuel or irradiation pins enclosed within an inner tube which in turn is enclosed within an outer coolant tube and includes a locking comb consisting of a head extending through one side of the inner sleeve and a plurality of teeth which extend through the other side of the inner sleeve while engaging annular undercut portions in the bottom portion of the fuel or irradiation pins to prevent movement of the pins.

28211 ELECTRIC CARTRIDGE-TYPE HEATER FOR PRODUCING A GIVEN NON-UNIFORM AXIAL POWER DISTRIBUTION. Clark, D. L.; Kress, T. S. (to U. S. Energy Research and Development Administration). US Patent 3,912,908. H05B3/10. 14 Oct 1975. Filed date 12 Nov 1974. 4p.

PAT-APPL-523,183.

An electric cartridge heater is provided to simulate a reactor fuel element for use in safety and thermal-hydraulic tests of

model nuclear reactor systems. The electric heat-generating element of the cartridge heater consists of a specifically shaped strip of metal cut with variable width from a flat sheet of the element material. When spirally wrapped around a mandrel, the strip produces a coiled element of the desired length and diameter. The coiled element is particularly characterized by an electrical resistance that varies along its length due to variations in strip width. Thus, the cartridge heater is constructed such that it will produce a more realistic simulation of the actual nonuniform (approximately "chopped" cosine) power distribution of a reactor fuel element.

28212 EFFECT OF TEMPERATURE DISTRIBUTION ON THE SWELLING OF UO_2 AND UO_2–PuO_2 CORES. Kuz'min, V. I.; Lebedev, I. G. Sov. At. Energy (Engl. Transl.); 38: No. 1, 10-14(Jan 1975).

Translated from At. Energ. (USSR); 38: No. 1, 11-15(Jan 1975).

The influence of temperature distribution in irradiated uranium dioxide and mixed oxide fuels on total porosity is investigated, and methods are considered for calculating the volume changes taking place in cylindrical oxide-fuel pellets. (auth)

Reactor Control Systems

28213 HYDRAULIC BALANCING OF A CONTROL COMPONENT WITHIN A NUCLEAR REACTOR. Marinos, D.; Ripfel, H. C. F. (to U. S. Energy Research and Development Administration). US Patent 3,912,582. G21C7/10. 14 Oct 1975. Filed date 16 Aug 1974. 8p.

PAT-APPL-498,147.

A reactor control component includes an inner conduit, for instance containing neutron absorber elements, adapted for longitudinal movement within an outer guide duct. A transverse partition partially encloses one end of the conduit and meets a transverse wall within the guide duct when the conduit is fully inserted into the reactor core. A tube piece extends from the transverse partition and is coaxially aligned to be received within a tubular receptacle which extends from the transverse wall. The tube piece and receptacle cooperate in engagement to restrict the flow and pressure of coolant beneath the transverse partition and thereby minimize upward forces tending to expel the inner conduit.

28214 PLANNING AND CONSTRUCTION OF MEASURING TECHNIQUE SYSTEMS. Hofmann, H. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Abt. Vertrieb). Arch. Tech. Mess. Messtech. Prax.; No. 472, R81-R87(May 1975). (In German).

The increasing number of measuring technique systems in nuclear power plants calls for rational planning methods. A clear system concept together with an extensive standardization of equipment and system technique enable the use of electronic data processing systems (EDV) as a planning aid. The problems and principles of the calculation-based planning of the measuring technique systems using standard measuring circles and an equipment catalogue specific to power plants are presented. (DE)

28215 NOVEL FEATURES IN INSTRUMENTATION AND AUTOMATION FOR THE CONTROL OF NUCLEAR POWER STATIONS. Prereport on the Subject of Technical Meeting No. 8. Hoermann, H.; Nieckau, E. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Analgensicherung). Kerntechnik; 17: No. 9/10, 441-445(Sep 1975). (In German, English).

The progress in the field of nuclear power plant control and supervision techniques during the three years since Nuclex 72 is reviewed. Special attention has been paid to the operational experiences gained and the fundamental aspects of new development work related to process control. In this context the growing use of computers is of particular importance. (DE)

Nuclear Power Plant Economics

28216 (Juel-1230) THE ENERGY INPUT IN THE CONSTRUCTION AND OPERATION OF NUCLEAR POWER STATIONS. Kolb, G.; Niehaus, F.; Rath-Nagel, S.; Voss, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Systemforschung und Technologische Entwicklung). Aug 1975. 73p. (In German). INIS.

The production of electric energy requires energy investments not only for direct fuel input but for the construction of power plants and for the extraction of primary energy fuels as well. When the overall energy balance of energy converting systems has to be assessed these energy investments must be included. In the present investigation the overall energy input of different nuclear power plant types (comprising the nuclear fuel cycle) is computed and compared with a coal-fired plant. Moreover a time-dependent energy balance for the expansion of nuclear capacity according to the existing nuclear programs is calculated. Even applying only light water reactors the nuclear expansion program (with an installed capacity of 50 GW(el) in 1985 and 170 GW(el) in 2000) would result in an accumulated fossil fuel saving of approximately ten times the yearly amount of primary energy consumed in the Federal Republic of Germany today. (DE)

28217 1974 RECORD OF GERMAN NUCLEAR POWER PLANT OPERATION. Atomwirtsch., Atomtech.; 20: No. 10, 525-535(Oct 1975). (In German).

11 figs.; 2 tabs. Full text published in At. Strom (No. 5/6) 1975.

In its annual report on operational experience with German nuclear power plants in 1974, the ABE Committee of the Deutsches Atomforum states that the gross power generation, with a value of about 12,300 GWh, was as high as the year before. This means that the contribution of nuclear energy to energy supply equals about 2.5 million tons of oil. The essential results of the report are presented. (DE)

28218 NUCLEAR POWER AND ITS ALTERNATIVES. Haefele, W.; Avenhaus, R.; Sassin, W.; Weingart, J. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Atomwirtsch., Atomtech.; 20: No. 10, 498-508(Oct 1975). (In German).

14 figs.; 16 tabs.; 19 refs. Revised paper presented at the Reactor meeting, Nuremberg, F. R. Germany, 8 Apr 1975.

On a medium term basis coal could be the only alternative to nuclear energy. However, coal might turn out to be a partner rather than a competitor of nuclear power. This applies above all to the consumer market demand for a gaseous source of secondary energy. The longer term exigencies of a secure and economical supply of primary energy require the establishment of a modern system of secondary energies as a top priority objective in which electricity is joined by a gaseous source of secondary energy. In the longer run, hydrogen is a likely candidate for this role; this would mean also that the two forms of secondary energy are mutually convertible. One of the consequences of this solution would be the possibility of storing secondary energy. In our latitudes solar energy, for the time being, can probably be used only on the basis of the "solar house." (DE)

28219 FOR AND AGAINST NUCLEAR POWER. Chapman, P. New Sci.; 68: No. 971, 142-143(16 Oct 1975).

It is shown how different views about the role of nuclear power lead to quite different, but mutually consistent, conclusions. The conclusions are consistent in that provided that nuclear stations are substituting for fossil-fired power stations, and not used as a way of promoting an all-electric fuel economy, and are not justified as a substitute for oil-wells or coal-mines, then nuclear power can help reduce fossil-fuel consumption. The failure to make this distinction, between substituting for primary or secondary fuels, has caused most of the controversy over the energy-analysis of nuclear power which has recently been raging. Another aspect of the debate concerns the desirability of an "all-electric" economy and the use of electricity for all purposes. It is shown that only between 20 and 30% of the fuel market could use electricity efficiently at the moment and this might rise to 35 to 45% if electric transportation systems were developed. (UK)

28220 THE NUCLEOELECTRICAL FILE. Couture, J. Rev. Energ.; 26: No. 273, 658-665(May 1975). (In French).

Various aspects of the French electronuclear policy are reviewed: economic and financial data, industrial problems, hazards, and harmful effects. Some indications concerning the perspectives offered by the future nuclear techniques are given. (FR)

Reactor Fuel Cycle Economics

Refer also to abstracts 25557–25559 and 28070.

28221 (Juel-Conf-14, pp 261-270) THE CLOSING OF THE FUEL CYCLE OF LIGHT-WATER REACTORS. Schmiedel, P. Jan 1975. (In German).

From status report of the Fachgruppe Brennelemente on fuel elements for LWR, HTR, SNR, GSB reactors; Juelich, F. R. Germany (12 Nov 1974).

4 figs. Available from ZAED.

In fuel elements for LWR, HTR, SNR, GSB reactors. Status report of the Fachgruppe Brennelemente. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)).

A survey is given on the most important problems concerning transport and reprocessing of spent LWR fuel elements. The two possibilities plutonium recycling and storage are discussed for the plutonium yielded in the reprocessing. (DE)

28222 (NP-20838) NUCLEAR POWER AND URANIUM FUEL: REQUIREMENTS IN THE WESTERN UNITED STATES. (Western

Interstate Nuclear Board, Lakewood, Colo. (USA)). Oct 1975. 37p. Western Interstate Nuclear Board, Lakewood, CO.

The results are presented of a survey of nuclear power and associated uranium fuel cycle requirements in the Western Region recently conducted by the Western Interstate Nuclear Board (WINB). The survey covers the period 1975–1990 for electric energy and nuclear power except for uranium and other fuel cycle requirements which is limited to the period 1975–1985. This shorter time span coverage for fuel cycle requirements was chosen due to many uncertainties in future federal policy in such areas as uranium enrichment, plutonium utilization in light water reactors, spent fuel reprocessing, and high-level radioactive waste management. Geographically, the survey covered the twelve western states served by WINB. Also contained is information on projected national and western regional trends in electric energy demand and supply developed by the U. S. Energy Research and Development Administration (ERDA), the Western Systems Coordinating Council (WSCC), and other organizations. This information is presented as background material for assessing nuclear power in the West and nation in its proper perspective as one of several major energy sources available for general application during the period 1975–1990.

28223 (RT/ING-73-2) FUEL CYCLE FOR NUCLEAR REACTORS. Fundamental Aspects: Processes and Economic Evaluations. Bruzzi, L.; Cicognani, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1973. 557p. (In Italian). INIS.

The various features of the fuel cycle are examined for thermal and fast power reactors. The fuel behavior during reactor operation and its transformations in fabrication, reprocessing and enrichment plants are discussed. Particular attention is devoted to the main features of the various phases of the fuel cycle, pointing out the connection with reactor design, economics and safety. (INIS)

28224 FINANCING THE NUCLEAR FUEL CYCLE. Stephany, M. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (F. R. Germany)). Atomwirtsch., Atomtech.; 20: No. 9, 412–414 (Sep 1975). (In German).

While conventional power stations usually have fossil fuel reserves for only a few weeks, nuclear power stations, because of the relatively long time required for uranium processing from ore extraction to the delivery of the fuel elements and their prolonged in-pile time, require fuel reserves for a period of several years. Although the specific fuel costs of nuclear power stations are much lower than those of conventional power stations, this results in consistently higher financial requirements. But the problems involved in financing the nuclear fuel do not only include the aspect of financing the requirements of reactor operators, but also of financing the facilities of the nuclear fuel cycle. As far as the fuel supply is concerned, the true financial requirements greatly exceed the mere purchasing costs because the costs of financing are rather high as a consequence of the long lead times. (DE)

28225 PRESENT POSITION ON THE PRIMARY ENERGY MARKETS. Gueltzow, H. A. (Hamburgische Electricitaets-Werke A. G. (F. R. Germany); Kernkraftwerk Brunsbuettel G.m.b.H. (F. R. Germany)). Elektrizitaetswirtschaft; 74: No. 16, 583-589(Aug 1975). (In German).

As well as other effects, the oil crisis has led to a shift in the competition between the energy sources. The article outlines the main factors which have so far influenced the primary energy markets and then deals with the present situation of the various markets and their expected future development. In this connection special attention is paid to the nuclear fuel cycle which has in the past been regarded often as giving rise to no problems, but which has faced the reactor operators with unexpected difficulties, at least in restricted areas. (DE)

28226 UTILIZATION OF NUCLEAR FUEL IN VARIOUS REACTORS. Graph Comparison. Ventre, E. Bull. Dir. Etud. Rech., Ser. A; No. 3, 51-58(1974). (In French).

The nuclear fuel required and the waste produced depend on the type of the nuclear reactor used. A graph is proposed which shows the quantity of fuel required to produce a given amount of electric power for any reactor design. (FR)

Reactor Licensing and Regulation

Refer also to abstracts 27956 and 28158–28160.

28227 (DOCKET-50003-497) INDIAN POINT STATION, UNITS 1 AND 2. Annual Operations Report No. 25, 1975. (Consolidated Edison Co. of New York, Inc., New York (USA)). 1 Mar 1976. 150p. (DOCKET-50247-582). Dep. NTIS $6.00.

Indian Point-1 Reactor remained in the shutdown condition in compliance with NRC's IAC for ECCS. Unit 2 generated 4,889,038 MWH(e) and was on line 8,323.1 hrs. Information is presented concerning operation, maintenance, occupational personnel radiation protection, primary coolant chemistry, abnormal occurrences, changes, tests, and experiments. (FS)

28228 (DOCKET-50010-499) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Semiannual Report, July–December 1975. (Commonwealth Edison Co., Chicago, Ill. (USA)). 11 Feb 1976. 202p. (DOCKET-50237-924; DOCKET-50249-755).

Unit 1 net electric power generated was 222,291.82 MWH(e) with the reactor on line 1501:13 hours, Unit 2 generated 2,697,540 MWH(e) and was on line 3979:06 hrs while Unit 3 generated 1,493,824 MWH(e) and was on line 2327:28 hrs. Information is presented concerning operations, fuel performance, surveillance, containment leak testing, shutdowns, maintenance, and primary coolant chemistry. (FS)

28229 (DOCKET-50133-342) HUMBOLDT BAY POWER PLANT, UNIT 3. Annual Operating Report, 1975. (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 26 Feb 1976. 26p. Dep. NTIS $4.00.

Information is presented concerning operations, changes and forced power reductions, radiation exposures, and fuel experience. (FS)

28230 (DOCKET-50146-129) SAXTON NUCLEAR EXPERIMENTAL REACTOR. Annual Report, 1975. (Saxton Nuclear Experimental Corp., Pa. (USA)). 25 Feb 1976. 4p. Dep. NTIS $3.50.

Information is presented concerning entries into the containment vessel, maintenance changes, surveys of radioactivity levels, water sample analyses, and performance of security and surveillance. (FS)

28231 (DOCKET-50213-484) HADDAM NECK PLANT. Annual Operating Report, 1975. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 1975. 57p. Dep. NTIS $4.50.

Gross electrical power generated was 2,464,308 MWh(e) with the reactor on line 4,417 hrs. Information is presented concerning operations, power generation, shutdowns, corrective maintenance, primary coolant chemistry, occupational radiation exposure, release of radioactive materials, reportable occurrences, changes in plant, technical specifications, core vi start-up, containment leak testing, and core v and vi refueling. (FS)

28232 (DOCKET-50244-497) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Annual Report No. 11, 1975. (Rochester Gas and Electric Corp., N. Y. (USA)). 27 Feb 1976. 233p. Dep. NTIS $8.00.

Information is presented concerning operations, power reductions, outages, personnel radiation exposures, failed fuel indications, procedure changes, system modification, and special tests. Results from radiation monitoring of dust, fallout, Lake Ontario water, well water, milk, fruit, aquatic ecosystems, and lake bottoms are tabulated. (FS)

28233 (DOCKET-50245-635) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Semiannual Operating Report, July–December 1975. (Northwest Nuclear Energy Co., Hartford, Conn. (USA)). 27 Feb 1976. 44p. Dep. NTIS $4.00.

Net electrical power generated was 1,525,943 MWh(e) with the reactor on line 2,682 hrs. Information is presented concerning power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, environmental effects monitoring, release of radioactive materials, and reportable occurrences. Occupational personnel radiation exposures will be submitted later. (FS)

28234 (DOCKET-50255-648) PALISADES NUCLEAR PLANT. First Annual Report of Operations, 1975. (Consumers Power Co., Jackson, Mich. (USA)). 5 Mar 1975. 201p. Dep. NTIS $7.75.

Information is presented concerning operations, maintenance, shutdowns, personnel exposures, failed fuel, refueling, and radioactive effluent releases. The radiological and nonradiological environmental monitoring programs are summarized. Changes, tests and experiments will be submitted by August 31, 1976. (FS)

28235 (DOCKET-50263-601) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Semiannual Operating Report, July–December 1975. (Northern States Power Co., Minneapolis, Minn. (USA)). 1 Mar 1976. 76p. Dep. NTIS $5.00.

Net electrical power generated was 1,103,754 MWH(e) with the reactor on line 2,743 hrs. Information is presented concerning power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, occupational radiation exposure, release of radioactive materials, and environmental radiation monitoring. (FS)

28236 (DOCKET-50305-380) KEWAUNEE NUCLEAR POWER PLANT, UNIT 1. Semiannual Operating Report, July-December 1975. (Wisconsin Public Service Corp., Green Bay (USA)). 26 Feb 1976. 370p. Dep. NTIS $10.50.

Net electrical power generated was 1,700,492 MWh(e) with the reactor on line 3,797.02 hrs. Information is presented concerning operations, power generation, shutdowns, corrective maintenance, radiochemistry, health physics, release of radioactive materials, reportable occurrences, design changes, reactor engineering, environmental technical specifications, and bio testing. (FS)

28237 (DOCKET-50315-462) DONALD C. COOK NUCLEAR POWER PLANT, UNIT 1. Annual Operating Report, 1975. (Indiana and Michigan Power Co., New York (USA)). 1975. 54p. Dep. NTIS $4.50.

Net electrical power generated was 4,457,836,000 MWH(e) with the reactor on line 6004.2 hrs. Information is presented concerning power generation, shutdowns, corrective maintenance, occupational radiation exposure, release of radioactive materials, changes, and fuel history. (FS)

28238 (DOCKET-50317-535) CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 1. Semiannual Operating Report, July-December 1975. (Baltimore Gas and Electric Co., Md. (USA)). 1975. 38p. Dep. NTIS $4.00.

Information is presented concerning operations, outages, forced reductions, irradiated fuel examination, personnel radiation exposures, changes, tests, experiments, power changes, and depressurization data. (FS)

28239 (DOCKET-50321-460) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Annual Operating Report, 1975. (Georgia Power Co., Atlanta (USA)). 27 Feb 1976. 121p. Dep. NTIS $5.50.

Net electrical power generated was 3,102,479 MWh(e) with the reactor on line 6,159 hrs. Information is presented concerning power generation, shutdowns, corrective maintenance, reactor coolant chemistry tests, occupational radiation exposure, release of radioactive materials, reportable occurrences, and primary containment local leak rate tests. (FS)

28240 (DOCKET-50324-615) BRUNSWICK STEAM ELECTRIC PLANT, UNIT 2. Annual Operating Report, 1975. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 27 Feb 1976. 225p. Dep. NTIS $7.75.

Initial criticality occurred in March and start-up testing continued for most of the year. Information is presented concerning operations, shutdowns, maintenance, design changes, personnel radiation exposures, thermal transients, safety/relief valve malfunctions, condenser tube leaks, and recirculation pump seal failures. (FS)

28241 (DOCKET-50333-486) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Semiannual Operating Report, July-December 1975. (Power Authority of the State of New York (USA)). 25 Feb 1976. 65p. Dep. NTIS $4.50.

Net electrical power generated was 1,824,209 MWh(e) with the reactor on line 3,229.2 hrs. Information is presented concerning operation, power generation, shutdowns, corrective maintenance, physics and testing, occupational radiation exposure, release of radioactive materials, and abnormal and reportable occurrences. (FS)

28242 (DOCKET-50336-373) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Operating Report, August-December 1975. (Northeast Nuclear Energy Co., Hartford, Conn. (USA)). 1 Mar 1976. 19p. Dep. NTIS $3.50.

Fuel loading started on August 2, 1975 and the reactor was declared commercial on December 26, 1975. Power ascension testing continued through 1975. Information is presented concerning outages, design changes, procedure changes and testing. (FS)

28243 (DOCKET-STN-50560-8) FLUOR PIONEER BALANCE OF PLANT STANDARD SAFETY ANALYSIS REPORT, BOPSSAR. License Application, Volume 1. (Fluor Pioneer, Inc., Chicago, Ill. (USA)). 14 Nov 1975. 274p. Dep. NTIS $9.00

A balance of plant (BOP) for use with a Westinghouse Standard Reactor, RESAR-41, a four loop, single unit NSSS, is presented for licensing. The designs of structures, systems, and components assures an adequate margin of safety at a power level of 3800 MW(t). Accident analyses were performed at 4100 MW(t). The containment system consists of a spherical steel containment vessel surrounded by a right circular reinforced concrete vessel topped with a thick hemispherical dome providing biological shielding, protection of the environment, and missile protection. (FS)

28244 (DOCKET-STN-50561-1) BABCOCK AND WILCOX SAFETY ANALYSIS REPORT (B-SAR-205). Volume 1. (Babcock and Wilcox Co., Lynchburg, Va. (USA)). 27 Feb 1976. 545p. Dep. NTIS $13.00.

The design of the BW-205 standard reactor with a plant output of 1295 and 1200 MW(e) is described. The reactor is arranged in two closed coolant loops connected in parallel to the reactor vessel, and is controlled by a coordinated combination of chemical shim and mechanical control rods. The coolant serves as a neutron moderator, reflector, and solvent for the soluble boron used in chemical shim reactivity control. The fuel elements consist of slightly enriched UO_2 pellets enclosed in zircaloy tubes.(FS)

28245 (FIND-STN-50508-R1) FIND: WPPSS Nuclear Project No. 3 and No. 5. Williams, W. H. (Ed.). (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 26p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report.

28246 (SAAS-186) QUALITY ASSURANCE SYSTEM FOR NUCLEAR POWER PLANTS IN THE GERMAN DEMOCRATIC REPUBLIC. Rabold, H. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Sep 1975. 17p. (In German). Dep. NTIS (US Sales Only) $3.50.

A governmental quality assurance system has been established in the GDR. From the very beginning its provisions have been applied to the nuclear energy field. The quality assurance system has been supplemented for quality control and licensing of nuclear plants by special provisions. Basic standards and engineering codes, assignment of responsibility, existent control bodies as well as the various controls in different processes are described. (auth)

28247 (STI/PUB-421) LICENSING AND REGULATORY CONTROL OF NUCLEAR INSTALLATIONS. Legal Series No. 10. Proceedings of Conferences held in Rio de Janeiro, 25-29 June 1973, and in Athens, 16-20 December 1974. (International Atomic Energy Agency, Vienna (Austria)). 1975. 316p. (In English and French). (CONF-7306129-; CONF-741260-). IAEA $19.00.

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973).

Abstracts for all 19 papers are included in NSA and abstracts for 2 papers are included in ERA. (JWR)

For abstracts of individual papers see: 25934, 25935, 28158-28160, and 28251-28264.

28248 (TID-27005) OPINIONS AND DECISIONS OF THE ATOMIC ENERGY COMMISSION WITH SELECTED ORDERS. Progress Report, July 1, 1972-December 31, 1972. (Energy Research and Development Administration, Washington, D. C. (USA)). 1974. 472p. GPO $8.40.

Issuances of the Atomic Energy Commission, the Atomic Safety and Licensing Board, the Atomic Safety and Licensing Appeal Board, and the Board of Contract Appeals during the period July through December 1972 are presented.

28249 NUCLEAR POWER PLANTS—OPERATIONAL ORGANIZATION AND SHIFT TEAM FROM THE EXPERT'S POINT OF VIEW. Wildberg, D. W. (Technischer Ueberwachungs-Verein Baden e.V., Mannheim (F. R. Germany). Abt. Kerntechnik und Strahlenschutz). Tech. Ueberwach.; 16: No. 10, 285-288(Oct 1975). (In German).

The guideline for the proof of expert knowledge of the nuclear power plant personnel published in October last year has also brought out uniform definitions for the operational organization. The important responsibility sections can be limited to four basic tasks which should independently stand alongside each other due to the mutual control. The requirements of the work shift are shown on the basis of the experience gained. (DE)

28250 STANDARDIZATION—ONE WAY OF IMPLEMENTING THE NUCLEAR POWER PROGRAM. Facius, H. (Kraftwerk Union A. G., Offenbach (F. R. Germany)). Atomwirtsch., Atomtech.; 20: No. 10, 508-510(Oct 1975). (In German).

If the Power Program of the Federal Republic of Germany is to be implemented, 45,000 MW(e) of nuclear generating capacity are to be installed by 1985. One important way of achieving this goal is the standardization of nuclear power stations, the preconditions to which have now been established in plant com-

missioning of the first 1300 MW(e) LWR plant. Standardization entails a number of advantages for the suppliers of nuclear power stations, for component manufacturers, power station operators and the licensing authorities including their technical consultants. (DE)

28251 LEGISLATIVE FRAMEWORK AND REGULATORY REQUIREMENTS FOR THE INTRODUCTION OF NUCLEAR POWER. Phuong, H. V. (International Atomic Energy Agency, Vienna). pp 3-15 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

The adoption of appropriate legislation is to be considered as a prerequisite to the introduction of nuclear power in view of the issues that need to be regulated. Preparatory steps should be started at the earliest stage in conjunction with the planning of nuclear power projects. The primary objectives of a licensing scheme are to ensure safety, public health and environmental protection as well as financial protection for third parties in case of nuclear incident. For licensing purposes, a legislative framework and regulatory determinations are required. Within such a framework and pursuant to such regulatory determinations, the elaboration of safety standards, rules, guides and enforcement procedures is to be considered of paramount importance. To this end a number of international recommendations and advisory material prepared by the IAEA provide useful guidance. A licensing process would normally be split into several stages relating to site approval, construction permit, pre-operational tests, and operating license, each stage being subject to safety assessments and reviews as determined by regulations. Financial protection against nuclear damage has also to be insured. A special regime of nuclear liability has been established by international conventions, based on the principle of strict liability of the operator of a nuclear installation. As a result of such channelling of liability to him, his liability is limited in amount and time. This liability system has the dual purpose of ensuring appropriate protection for potential victims and of relieving the nuclear industry from unlimited liability risks, which would impede practical applications of atomic energy. For the elaboration of nuclear legislation and specialized regulations the Agency's advisory services have proved to be of help to countries embarking on a nuclear power program. (auth)

28252 EXISTING AND PLANNED NATIONAL LEGISLATION ON NUCLEAR ACTIVITIES IN MEXICO. Ortiz Monasterio, E. (Mexican National Nuclear Energy Inst., Mexico City). pp 17-28 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

The Mexican constitutional and institutional frameworks for carrying out nuclear activities are described. Responsibilities in this field are vested in the Federal Government. The National Nuclear Energy Institute is vested with both promotional and regulatory functions. It performs licensing and control functions over the production and uses of radioactive materials as well as the establishment of nuclear installations. The Federal Electricity Commission is responsible for electricity generation. The implementation of nuclear power projects is accordingly part of its statutory functions. Mexico has legislation covering the exploitation of radioactive ores, the manufacture and trade of nuclear substances, the licensing of nuclear facilities and third party liability consistent with international conventions. Regulations are under preparation for protection of radiation workers and for licensing nuclear power plants. (auth)

28253 SAFETY ASPECTS OF NUCLEAR PLANT LICENSING IN CANADA. Jennekens, J. H. F. (Atomic Energy Control Board, Ottawa). pp 29-38 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

The legislative authority is laid down in the Atomic Energy Control Act, 1946, declaring atomic energy a matter of national interest and establishing the Atomic Energy Control Board (AECB) as the competent body for regulating all aspects of atomic energy. The Act also vests a Minister designated by the Government with research and exploitation functions; thus, by Ministerial order, Atomic Energy of Canada Limited was established in 1952 as a State-owned company. The Nuclear Liability Act, 1970, channels all liability for nuclear damage to the operator of a nuclear installation and requires him to obtain insurance in the amount of $75 million, part of which may be re-insured by the Government. The licensing requirements comprise the issuance of a site approval, a construction license and an operating license. The AECB is assisted in its licensing functions by its Nuclear Plant Licensing Directorate and by the Reactor Safety Advisory Committee co-operating with each other in making extensive safety assessments of a license application. A site evaluation report, a preliminary safety report and a final safety report are required in relation to the siting, construction and operation of a nuclear power plant. The Canadian reactor safety philosophy is based on the concept of defense in depth, implemented through a multi-step approach, which includes avoidance of malfunctions, provision of special safety systems, periodic inspection and testing, and avoidance of human errors. Specific criteria and principles have evolved in applying this basic safety philosophy and radiation protection standards are derived from international recommendations. Stringent control is exercised over the management of radioactive waste and management facilities must meet the engineering and procedural requirements of AECB before they can be placed in operation. (auth)

28254 SAFETY CRITERIA AND PROCEDURAL STEPS CONNECTED WITH THE LICENSING OF NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Franzen, L. F. (Technischer Ueberwachungs-Vereine eV, Cologne). pp 39-57 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

The Federal Republic of Germany is a centralized confederacy of States, whose Constitution was amended in 1959 to define the respective responsibilities of the Federal and State authorities in the peaceful use of nuclear energy. Nuclear legislation is enacted at the federal level but its implementation is the responsibility of States. The Atomic Energy Act, 1959, sets forth licensing requirements that are more stringent than in any other technical field and, also, provides for a licensee's absolute liability for nuclear damage. The amount of his financial security is determined by the licensing authority, subject to review every two years. Other applicable provisions are to be found in the Radiation Protection Ordinance, 1960, the Nuclear Installations Ordinance, 1970, and a number of public laws governing planning, construction works, water use, electricity supply, trade, and transport, environmental protection, etc. The safety criteria used for licensing purposes, first developed as guidelines and based on the US criteria, were replaced by safety criteria for nuclear power plants approved in 1974. Safety criteria are supplemented by safety guides providing procedures for meeting specific safety requirements. Prescribed safety precautions include safety analysis of the siting and plant design, quality control, recurrent inspections and emergency precautions. The licensing process is conducted by State authorities, in consultation with and under the supervision of a responsible Federal Ministry, which is assisted in such duties by an Advisory Committee on Reactor Safeguards. The Reactor Safety Institute and other technical expertise are called upon for advice on safety assessments and for inspections connected with a license application and enforcement. The licensing of a nuclear installation may consist in provisional decisions and partial licenses related to siting and plant design prior to the granting of a construction or an operating license. Public announcement of a proposed installation is required by law and objections thereto may be discarded by the licensing authority if unfounded, otherwise such objections are to be taken care of by means of licensing conditions. (auth)

28255 LICENSING OF NUCLEAR POWER PLANTS IN THE UNITED STATES OF AMERICA WITH SPECIAL EMPHASIS ON ENVIRONMENTAL PROTECTION. Becker, J. M. (Atomic Energy Commission, Washington, DC). pp 59-77 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From Seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

The National Environmental Policy Act (NEPA), 1969, and its interpretation by federal courts have resulted in a significant change in the licensing of nuclear facilities in the USA. Application for a construction permit must be accompanied by a safety analysis report and an environmental report. Concurrently with safety reviews performed by the regulatory staff of the Atomic Energy Commission and the Advisory Committee on Reactor Safeguards (ACRS), an environmental review is carried out. Separate public hearings are held to consider the safety and environmental issues involved. After a decision is issued by the Atomic Safety and Licensing Board, a party may appeal to an Appeal Board and the Appeal Board's decision may be subject

to review by the Commission. Application for an operating license must include a final safety analysis report and a second environmental report, which again are reviewed by the Commission's staff and ACRS. An opportunity for public hearing is afforded upon completion of this review process. Apart from NEPA, the most important environmental protection statute involved in the licensing of nuclear power reactors is the Federal Water Pollution Control Act, which regulates discharges into navigable waters. Other applicable provisions are contained in the Clean Air Act, the Wild and Scenic Rivers Act and the National Historic Preservation Act. (auth)

28256 WAYS AND MEANS OF INSURING AGAINST NUCLEAR RISKS. Campbell Miles, A. (British Insurance (Atomic Energy) Committee, London). pp 79-87 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

Despite stringent safety requirements imposed upon nuclear installations, the need for adequate insurance cover is motivated by the consideration that a nuclear accident could lead to very grave consequences. To marshal the large insurance capacity required, national pools were formed in many countries, which may enter into arrangements with other similar national pools to increase their own capacity with a view to an appropriate spread of the risks involved. In the absence of a national nuclear pool, application for nuclear insurance would normally be made to the national insurance market association concerned. Virtually every type of nuclear risk is insurable; various forms of material damage and liability insurances are available. The financial liability of nuclear operators is established by national legislation on the basis of international conventions. Insurance coverage is linked to the operator's amount of liability established by law. A third party nuclear liability insurance policy usually consists of three parts: Part I covers the operator's liability under his domestic nuclear legislation; Part II provides non-nuclear power for accidents on the site up to a separate liability limit selected by the operator; and Part III provides cover for costs. Other types of insurance deal with damage to the site and the installation (material damage), consequential losses, contingent liabilities of suppliers of goods and services (products liability), nuclear material in transit and nuclear-propelled ships. (auth)

28257 PRACTICAL PROBLEMS OF THIRD PARTY LIABILITY CONNECTED WITH NUCLEAR INSTALLATIONS. Lacroix, F. (Commission Permanente du Risque Atomique du Comite Europeen des Assurances, Brussels). pp 89-95 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975). (In French).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

A special regime of liability for nuclear damage was established by the Paris Convention, 1960, and the Vienna Convention, 1963. The same basic principles are embodied in both Conventions. Some discrepancies, however, still exist between them despite the adoption of an additional protocol to the Paris Convention in 1964 for harmonization purposes. Practical problems facing insurers and suggestions for suitable solutions are presented. International transport of nuclear material raises, in particular, complex issues. With regard to civil liability arising out of the carriage of nuclear material by sea, a possible conflict between maritime transport conventions and nuclear liability conventions was resolved by the Brussels' Convention, 1971. Wider ratification of the nuclear conventions appears to be the only way for coping with some remaining difficulties, in particular with respect to nuclear material in transit.

28258 NOTES ON THIRD PARTY LIABILITY FOR NUCLEAR DAMAGE IN CONNECTION WITH THE CONSTRUCTION OF THE FIRST NUCLEAR POWER PLANT IN BRAZIL. Simoes, A. C. (National Nuclear Energy Commission (CNEN), Rio de Janeiro). pp 97-99 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Rio de Janeiro, Brazil (25 Jun 1973). See STI/PUB-421; CONF-7306129-.

Responsibilities for the construction and operation of the first nuclear power plant have been transferred from the National Nuclear Energy Commission to Electrobras, a public undertaking set up for this purpose. In view of such transfer of responsibilities and the implementation of further nuclear power projects, liability for nuclear damage has to be regulated in a way consistent with international conventions. A working group associating representatives of national authorities and public utilities was entrusted with the task of drafting rules for co-ordinating their respective activities in relation to the execution of the first nuclear power project; these rules were issued by Ministerial order in 1970. The working group also prepared a draft law on civil liability for nuclear damage, based on the Vienna Convention. This draft law has reached its final stage and, after promulgation, will enable Brazil to ratify the Vienna Convention. (auth)

28259 IAEA ACTIVITIES AND ASSISTANCE IN REGULATORY MATTERS CONNECTED WITH NUCLEAR POWER PROJECTS. Phuong, H. V. (International Atomic Energy Agency, Vienna). pp 131-133 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

The IAEA program for 1975–1980 includes accelerated work on the codes and guides to provide a standard frame for assessing the safety and reliability of nuclear power plants. The established procedure for such work and different types of documents to be produced are outlined. The Agency's advisory services in regulatory matters connected with nuclear power projects have been provided to several developing countries in recent years and are expected to be requested by an increasing number of countries going nuclear in conjunction with the changing energy situation. (auth)

28260 WORK OF THE OECD NUCLEAR ENERGY AGENCY ON SAFETY AND LICENSING OF NUCLEAR INSTALLATIONS. Strohl, P. (OECD Nuclear Energy Agency, Paris). pp 135-139 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

The acceleration of nuclear power programs in OECD Member countries is reflected in the emphasis given by OECD/NEA to its activities in nuclear safety and regulatory matters. Particular effort is devoted to work on radiation protection and radioactive waste management, safety of nuclear installations and nuclear law development. A Committee on the Safety of Nuclear Installations reviews the state of the art and identifies areas for research and co-ordination of national programs. A Sub-Committee on Licensing collates information and data on licensing standards and practices of different countries with a view to considering problems of common interest. Comparative studies of various licensing systems and discussions between licensing authorities should help to improve regulatory control of nuclear installations for which there appears to be a need for internationally accepted standards in the long run. (auth)

28261 ROLE OF ADVISORY COMMITTEES IN THE LICENSING OF NUCLEAR FACILITIES IN CANADA. Jennekens, J. H. F. (Atomic Energy Control Board, Ottawa). pp 149-167 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

The Reactor Safety Advisory Committee was established in 1956 to advise the Atomic Energy Control Board on all aspects of the safety of nuclear reactors. Subsequently, other advisory bodies have been set up for various purposes in the licensing process but their structure and working procedures are quite similar. As illustration, a study is made of the composition and functioning of the Reactor Safety Advisory Committee. A general schematic chart of the licensing process is provided in the annexes. (auth)

28262 LICENSING AND REGULATORY CONTROL OF THERMAL POWER REACTORS IN THE UNITED KINGDOM. Gronow, W. S.; Gausden, R. (Nuclear Installations Inspectorate, London). pp 205-221 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

The regulation of nuclear safety and liability in the United Kingdom is governed by the Nuclear Installations Acts 1965 and 1969. A site license is required for the construction or operation of a nuclear reactor or other prescribed installation. The responsible Minister is vested with broad regulatory powers for licensing purposes. The Nuclear Installations Inspectorate, set up in 1959, is responsible for safety assessments of proposed facilities and for inspection during construction, commissioning and operation. The power to impose and enforce conditions attached to a license gives the Nuclear Inspectorate adequate control over the design

and construction of a nuclear plant and its operation. While there have been changes in the form and content of various license conditions over the past decade, the practice is still to keep the licenses as free from technical detail as far as practicable, consistent with the need to define the extent of control. The license conditions and the procedural and technical documents drawn up thereunder provide a framework for safety control. The extent to which provisions can be made for emergency countermeasures is an essential feature of the United Kingdom siting policy.

28263 RECENT EFFECTIVE AND PROPOSED IMPROVEMENTS IN THE NUCLEAR POWER PLANT LICENSING PROCESS IN THE UNITED STATES OF AMERICA. Engelhardt, T. F. (Atomic Energy Commission, Washington, DC). pp 223-241 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

In his 18 April 1973 message to Congress on energy the US President noted that nuclear technology represented an indispensable source of energy for meeting current requirements and stated the need to avoid unreasonable delays in developing nuclear power by streamlining licensing procedures and by reducing overlapping jurisdictions. The Energy Reorganization Act of 1974 abolished the Atomic Energy Commission and transferred its licensing and regulatory functions to an independent regulatory commission, the Nuclear Regulatory Commission; a new Energy Research and Development Administration was concurrently established, vested with central responsibility for the planning, management and conduct of the Government's energy research and development. A number of administrative and legislative reforms that have been taken or are under way to improve and shorten the present nuclear facility licensing and regulatory process are described. It is estimated that full implementation of the "standardization" and "early site permit" concepts could reduce the overall time required to bring a nuclear power plant on line from the current ten years to six years or less. And this is being aimed at without compromising the thoroughness of the safety, environmental or antitrust licensing reviews, or sacrificing public participation in the licensing process. (auth)

28264 SURVEY OF DIFFERENT REGULATORY PRACTICES. pp 255-304 of Licensing and Regulatory Control of Nuclear Installations. Vienna; International Atomic Energy Agency (1975).

From seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974). See STI/PUB-421; CONF-741260-.

A survey is presented of legislation governing the licensing of nuclear installations in OECD Member countries prepared by a Sub-Committee on Licensing for the OECD/NEA Committee on the Safety of Nuclear Installations. (auth)

GENERAL AND MISCELLANEOUS

Information Handling

Refer also to abstracts 25565 and 27354.

28265 INTERNATIONAL NUCLEAR INFORMATION SYSTEM. Iung, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Documentation). pp 217-237 of Documentation Networks and Systems. Guilloux, R. (comp.). Paris, France; Gauthier-Villars (1975). (In French).

The essential characteristics of the International Nuclear Information System are presented: basis, organization, input, centralized processing, products supplied, cost and utilization of the system. (FR)

Law

Refer also to abstract 26231.

28266 (INIS-mf-1753) THE NATIONAL INSTITUTE OF NUCLEAR ENERGY. Medrano D, C. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Derecho). 1974. 89p. (In Spanish). INIS.

The legal aspects of the Instituto Nacional de Energia Nuclear in Mexico are examined. The law creating the institute is analyzed critically and the supplementary legislation affecting it is reviewed. A possible Latin American cooperation for the exploitation of the nuclear reserves of the area based on the application of a common technology and under one political agency. The purpose of such a Latin American cooperative agency would be to obtain energy self-sufficiency. Problems to be solved in its creation are analyzed. (JSR)

28267 SICHERHEITSTECHNIK. Bd. 3. Ergaenzbare Sammlung der Vorschriften Nebst Erlaeuterungen fuer Unternehmen und Ingenieure. (Safety Engineering. Vol. 3. Supplementable Loose-Leaf Collection of the Regulations with Explanations for Plants and Engineers). Schmatz, H. (Bayerisches Staatsministerium fuer Arbeit und Sozialordnung, Muenchen (F. R. Germany)); Noethlichs, M. (Bundesministerium fuer Arbeit und Sozialordnung, Bonn (F. R. Germany)). Berlin, F. R. Germany; Schmidt (1969). vp. (In German).

A study is made of the text and explications of the 1st and 2nd Radiation Protection Ordinance, the X-ray Ordinance, Competence Regulations of the Federal Lands, administrative regulations, guidelines and directions. (DE)

Management

Refer also to abstracts 26077 and 27170.

28268 (ANL-76-1) ARGONNE NATIONAL LABORATORY PATENT PORTFOLIO. Huguelet, B. C. (comp.). (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. 53p. Dep. NTIS $5.50.

This booklet contains the abstracts of all active U. S. patents on technology items that originated at ANL, the applicability of which is not limited to nuclear reactors. Also listed are the titles of all ANL-originated nuclear-related U. S. patents that are still in force. Selected technology items for which patent applications have been filed and are available for licensing are included in several categories. Categories included in this booklet are as follows: atmospheric and earth sciences; biological and medical sciences; chemistry and chemical engineering; cryogenics and superconductivity; electronics and electrical engineering; energy conversion; measurements and controls; methods and devices; materials and fabrication; physics, accelerators and fusion; and selected nuclear-related technology. (RWR)

28269 (DEU-73-28(Ed.1974)) BUSINESS REPORT 1974. (Kraftanlagen A. G., Heidelberg (F. R. Germany)). 1974. 40p. (In German). INIS.

With figs. and tabs. Available from ZAED.

In their business report, Messrs. Kraftanlagen Heidelberg AG present their balance for 1974 as well as the order position and the development of the firm in that year. (DE)

28270 (KFK-2125) THE SCIENTIFIC PUBLICATIONS OF THE KARLSRUHE NUCLEAR RESEARCH CENTRE IN THE YEAR 1974. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Apr 1975. 67p. (In German). INIS.

Report KFK 2125 contains all the titles of those publications which were printed in 1974. Lectures are included if the written version is available in the Central Library. Only those patents specified in a certain way (Ersterteilung, Auslegeschrift, Offenlegungsschrift) are listed. The list of publications is arranged according to institutes. Project reports and publications of project staff members are included. The list also includes those publications printed in the Kernforschungszentrum concerned with the research and development projects which are carried out by the Gesellschaft fuer Kernforschung in cooperation with other firms and organizations. In addition, the publications of the Institut fuer Strahlentechnologie der Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, situated on the premises of the Kernforschungszentrum, are given. (DE)

Mathematics and Computers

28271 MINI-EVM V EKSPERIMENTAL'NOI FIZIKE. (MINICOMPUTERS IN EXPERIMENTAL PHYSICS). Kutsenko, A. V.; Polos'yants, B. A.; Stupin, Yu. V. Moscow; Atomizdat (1975). 288p.

A general description of minicomputers, their characteristics, and classification is given from the viewpoint of their use in experimental physics as a tool of the experimenter. A comparative tabulation is given of the minicomputers manufactured. The apparatus set-up and the program safeguards, satisfying different levels of experimental automation, are examined in detail. Auxiliary equipment is described. Characteristic examples are cited of the use of minicomputers in experimental physics. 67 figures, 22 tables, 201 references. (tr-auth)

COMPLETE OR PARTIAL COLLECTIONS OF ERDA REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, International Atomic Energy Agency (IAEA)
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Brussels, European Atomic Energy Community (Euratom)
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atómica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd.
Hamilton, Ontario, McMaster University
Ottawa, National Research Council

CONGO, REPUBLIC OF
Kinshasa, Trico Nuclear Center

DENMARK
Risö, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Karlsruhe, Zentralstelle für Atomkernenergie Dokumentation
Munich, Technische Universität

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Institute

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Ispra, Cetis Library
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energía Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Boston Spa, Wetherby, Yorkshire, British Library Lending Division
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra, Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
British Library Lending Division
Boston Spa, Wetherby, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

UNITED STATES ENERGY RESEARCH
AND DEVELOPMENT ADMINISTRATION
P. O. BOX 62
OAK RIDGE, TENNESSEE 37830

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

POSTAGE AND FEES PAID
U. S. ENERGY RESEARCH
AND DEVELOPMENT ADMINISTRATION

U.S.MAIL

U.S.MAIL

XEROX UNIVERSITY MICROFILMS
SERIALS DEPT.
300 N. ZEEB ROAD
ANN ARBOR, MI 48106

Recent Publication in the ERDA Symposium Series

Atmosphere-Surface Exchange of Particulate and Gaseous Pollutants (1974)

Proceedings of a symposium held at Richland, Washington, September 4–6, 1974
Sponsored by Battelle, Pacific Northwest Laboratories, and Division of Biomedical and Environmental Research, U. S. Atomic Energy Commission

Coordinators
Rudolf J. Engelmann
George A. Sehmel

Published by the Technical Information Center, Office of Public Affairs, Energy Research and Development Administration
1976. 1000 pages, 6 by 9 inches, paper binding
Library of Congress Catalog Card No. 75-38716 (CIP)

Available as CONF-740921 for $13.60 (foreign, $16.10) from National Technical Information Service
U. S. Department of Commerce
Springfield, Va. 22161

Increasing energy demands suggest that air pollution probably could become more serious. For control and for the prediction of possible environmental effects from that pollution, data are needed by those planning national and local energy strategies. Pollution insertion rates and removal rates from local and regional sources must be known. This volume discusses atmospheric removal by dry deposition and insertion rates by resuspension.

Much of this research has been directed toward predicting the behavior of inadvertent emissions from nuclear facilities, but particle motion basically is not controlled by particle toxicity; thus even the nuclear research results apply also to nonnuclear emissions such as fossil-fuel particulates and gaseous sulfur emissions.

The 58 papers in this volume are a state-of-the-art statement of deposition and resuspension.